

# HCFL/56

## *V.90/K56flex™ PC Card Device Sets for Host-Controlled, Low Power Applications*

Conexant™ HCFL/56 PC Card Device Sets support high-speed analog data up to 56 kbps, 14.4 kbps fax, voice/TAM, analog cellular direct connect, and speakerphone (optional) operation (Table 1). The modem supports ITU-T V.90/K56flex™, V.34 and V.32bis data modulations and is designed to operate with dial-up telephone lines in the U.S. and worldwide. 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.

The device set consists of a PCMCIA bus interface device (L5502-11 PCMCIA BIF) in a 128-pin TQFP and a modem data pump (MDP) in a 144-pin TQFP or 100-pin PQFP. Host modem software is provided and the downloadable architecture allows updating of MDP executable code.

The L5502-11 PCMCIA bus interface device supports two peripheral channels, one channel for the modem and a second channel for an optional user-defined function (Function 2).

In V.90/K56flex mode, 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, the modem operates at line speeds up to 33.6 kbps. Error correction (V.42/MNP 2-4) and data compression (V.42bis/MNP 5) maximize data transfer integrity and boost average data throughput. Non-error-correcting mode is also supported.

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

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.

## Features

- Data modem
  - ITU-T V.90 and K56flex, V.34 (33.6 kbps), V.32 bis, V.32, V.22 bis, V.22, V.23, and V.21; Bell 212A and 103
  - V.42 LAPM and MNP 2-4 error correction and MNP 10 error correction
  - V.42 bis and MNP 5 data compression
  - V.250 (ex V.25 ter) and V.251 (ex V.25 ter Annex A) commands
  - Fax modem send and receive rates up to 14.4 kbps, ITU-T V.17, V.29, V.27 ter, and V.21 channel 2
  - EIA/TIA 578 Class 1 and T.31 Class 1.0 commands
  - MNP 10EC™ enhanced cellular performance
- Analog cellular direct connect
- V.80 synchronous access mode supports host-based communication protocols
  - H.324 interface support
- World-class operation
  - Call progress
  - Blacklisting
  - Multiple country support
- Voice, telephony, TAM
  - V.253 commands
  - 8-bit  $\mu$ -Law/A-Law coding (G.711)
  - 8-bit/16-bit linear coding
  - 8000/7200 Hz sample rate
  - Music on hold from host or analog hardware input
  - TAM support with concurrent DTMF detect, ring detect, and caller ID
  - Handset support (S models)
- Signal Processing Option
  - Hardware-based for minimal host loading.

**Table 1. Modem Models and Functions**

Model/Order/Part Numbers				Supported Functions			
Marketing Model Number <sup>1</sup>	Device Set Order Number	PCMCIA Bus Interface Device [128 TQFP] Part No.	MDP [144-TQFP] Part No.	V.90 and K56flex Data	V.34 Data,	V.32 bis Data, Fax CI 1 and 2, W-Class, Voice/TAM, Cellular	FDSP
HCFL/56S-PCC	DS56-L491-011	L5502-11	R6785-21	Y	Y	Y	Y
HCFL/56-PCC	DS56-L490-011	L5502-11	R6785-24	Y	Y	Y	-
Marketing Model Number <sup>1</sup>	Device Set Order Number	PCMCIA Bus Interface Device [128 TQFP] Part No.	MDP [100-PQFP] Part No.	V.90 and K56flex Data	V.34 Data,	V.32 bis Data, Fax CI 1 and 2, W-Class, Voice/TAM, Cellular	FDSP
HCFL/56S-PCC	DS56-L491-001	L5502-11	R6764-21	Y	Y	Y	Y
HCFL/56-PCC	DS56-L490-001	L5502-11	R6764-24	Y	Y	Y	-
<b>Notes:</b>							
1. Model options (Y = Supported, - = Not supported, O = Optional):							
PCC           PC Card host interface							
S            Speakerphone							
2. Supported functions (Y = Supported; - = Not supported)							
Cellular     Analog cellular direct connect							
Fax CI 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 S model)							

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**Introduction** (Continued from first page)

S models support position independent, full-duplex speakerphone (FDSP) operation using microphone and speaker, as well as other voice/TAM applications using handset or headset.

Fax Group 3 send and receive rates are supported up to 14.4 kbps with T.30 protocol.

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

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

Accelerator kits and reference designs are available to minimize application design time and costs.

**Features** (Continued from first page)

- Full-duplex speakerphone (FDSP) mode (S models)
  - Telephone handset interface
  - External microphone and speaker interface
  - Microphone gain and muting
  - Speaker volume control and muting
  - Adaptive acoustic, line, and handset echo cancellation
  - Loop gain control, transmit and receive path AGC
- Data/Fax/Voice call discrimination
- Single profile stored in host
- System Compatibilities
  - Windows 95, Windows 95 OSR2, Windows 98, Windows NT 4.0, Windows 2000 operating systems
  - Microsoft's PC 98 Design Initiative compliant
  - Unimodem/V compliant
  - Pentium 133 MHz equivalent or greater
  - 16 Mbyte RAM or more
- Communication software compatible AT command sets
- NVRAM directory, stored profiles, and CIS table (option)
- Internal phase-locked loop (PLL)
- Built-in host/DTE interface with speeds up to 230.4 kbps
- PC Card interface supports two functions with programmable I/O window size
- Flow control and speed buffering
- Automatic format/speed sensing
- Caller ID and distinctive ring detect
- JTAG Boundary Scan support
- Flexible PQFP and TQFP packaging options
  - L5502-11 PCMCIA BIF: 128-pin TQFP
  - MDP: 144-pin TQFP or 100-PQFP
- +3.3V operation with +5V tolerant inputs
- Sleep Mode
- Power use (mW, typical):

Device	Normal	Sleep
L5502-11	165	10
MDP	250	33

**Description**

**General**

The modem device set, consisting of separate PCMCIA Bus Interface (L5502-11) and modem data pump (MDP) devices, provides the processing core for a complete modem design. The OEM adds BIF crystal, discrete components, and a telephone line/telephone/voice/-TAM/analog cellular interface circuit to complete the modem system. Table 1 shows the supported functions by product family.

Dialing, call progress, V.80, telephone line interface, voice/TAM, speakerphone, and analog cellular phone interface functions are supported and controlled through the AT command set. Connection to the host/DTE is supported by the PC Card interface (Figure 1).

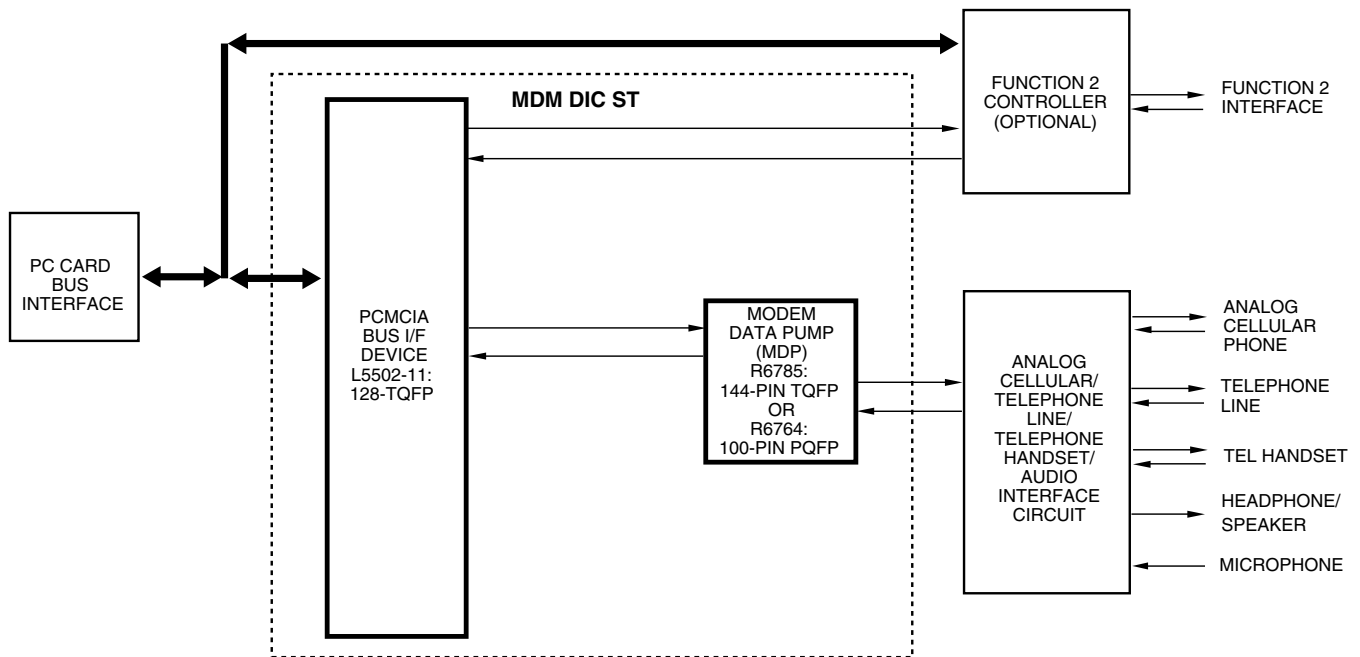
For U.S. operation, the modem can operate with a 1-relay data/fax/TAM DAA interface (Figure 2) or a 2-relay data/fax/TAM/V.61/Speakerphone DAA interface (Figure 3).

**Host Modem Software**

The host modem software performs two distinct tasks:

1. General modem control which includes command sets, fax Class 1, voice/TAM, speakerphone, error correction, data compression, cell phone drivers, and operating system interface functions.
2. Modem data pump control. Binary executable code controlling MDP operation is downloaded as required during operation. Signal processing, including data and fax modulation and demodulation, as well as voice sampling, is performed in the hardware DSP.

Configurations of the modem software are provided to support the modem models listed in Table 1.



md-247F1-1BD-PC

**Figure 1. Block Diagram**

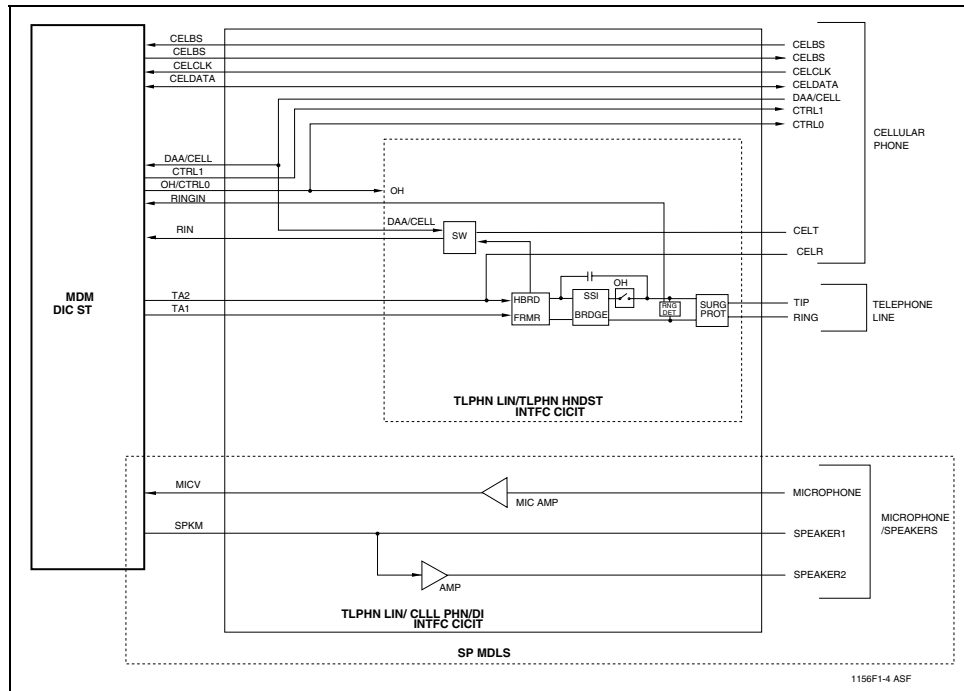


Figure 2. Relay Data/Fax/TAM DAA Interface (U.S.)

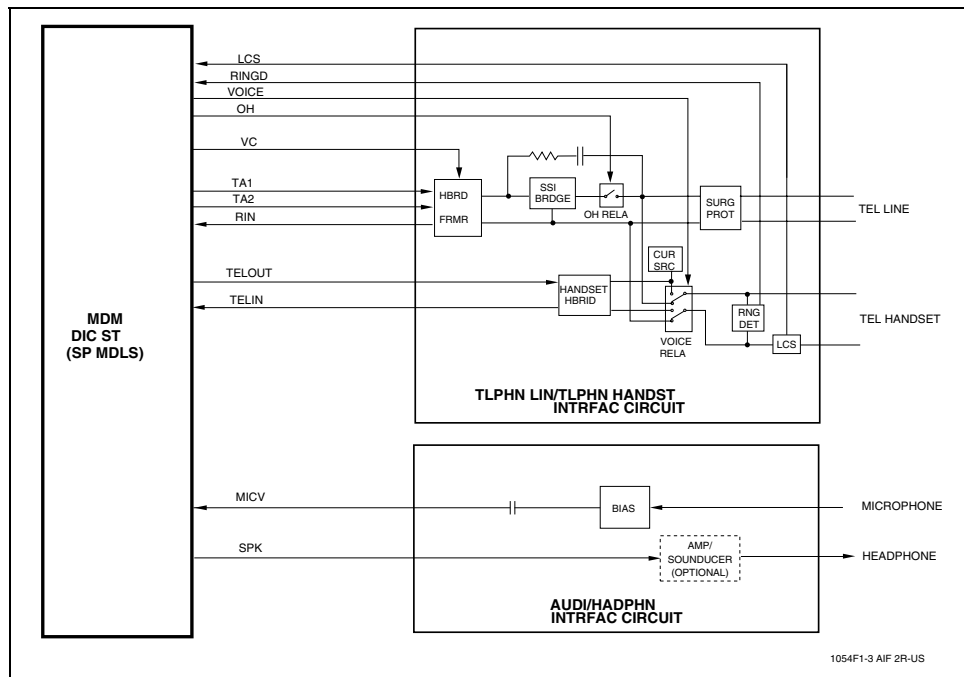


Figure 3. Relay Data/Fax/TAM/Spakerphone DAA Interface (U.S.)

## Operating Modes

### Data/Fax Modes

In V.90/K56flex data modem mode, 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, and to lower rates as dictated by the line conditions.

In V.34 data modem mode, 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.

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 14400, 12000, 9600, 7200, 4800, and 2400 bps. 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.

### Synchronous Access Mode (SAM) – Video Conferencing

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 programmable parameters are included in the .INF file for customization by the OEM.

### Voice/TAM Mode

Voice/TAM Mode features include 8-bit  $\mu$ -Law, A-Law, and linear coding at 8000 Hz and 7200 Hz sample rates. Tone detection/generation, call discrimination, and concurrent DTMF detection are also supported. ADPCM (4-bit IMA) coding is also supported to meet Microsoft WHQL logo requirements.

Voice/TAM Mode is supported by three submodes:

1. Online Voice Command Mode supports connection to the telephone line or, for S 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 S 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 S models, a speaker/handset.

### Speakerphone Mode (S Models)

The S models include additional telephone handset, external microphone, and external speakerphone interfaces which support voice and full-duplex speakerphone (FDSP) operation.

Hands-free, full-duplex telephone operation is supported in Speakerphone Mode under host control. Speakerphone Mode features an advanced proprietary speakerphone algorithm which supports full-duplex voice conversation with acoustic, line, and handset 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 host can separately control volume, muting, and AGC in microphone and speaker channels.

### Sleep Mode

Sleep Mode is supported in the modem device set.

## Cellular Phone Support

Cell phone operation is supported by a generic hardware interface conforming to multiple standards, and by host software for specific cell phone types. Conexant provides a software developer's kit to assist with software development for specific cell phone types. The kit enables straightforward porting of analog cell phone drivers to the modem. Refer to the software release notes for a list of the latest supported cell phone models.

## Modem Data Pump (MDP)

The data/fax/voice/speakerphone modem data pump (MDP) is a Conexant R6785 packaged in a 144-pin TQFP or an R6764 packaged in a 100-pin PQFP. The input clock frequency is 28.224 MHz and is supplied by the L5502-11 PCMCIA BIF. An internal phase locked loop (PLL) circuit supports 56.448 MHz internal operation. The operating voltage is +3.3V supplied by the L5502-11 PCMCIA BIF 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.

## Supported Interfaces

The major hardware signal interfaces of the modem device set are identified in Figure 4.

## PCMCIA Bus Interface (L5502-11 BIF)

The L5502-11 PCMCIA BIF connects to a PC Card socket via built-in PC Card interface and is packaged in a 128-pin TQFP. The operating voltage is +3.3V with +5V tolerant inputs.

The L5502-11 PCMCIA BIF performs the host interface functions. The crystal frequency is 28.224 MHz. The device outputs a 28.224 MHz clock to the MDP eliminating need for a separate MDP crystal circuit.

The L5502-11 PCMCIA BIF connects to the MDP via dedicated lines and the external bus. The L5502-11 PCMCIA BIF also has 32 kbytes of internal RAM.

## PC Card Interface

The L5502-11 PCMCIA BIF incorporates a built-in PC Card interface and CIS memory allowing the L5502-11 PCMCIA BIF 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.

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 internal modified ROM code 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

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 L5502-11 PCMCIA BIF. 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 ( $\sim$ CH2CS), power down ( $\sim$ PWRDWN2), reset ( $\sim$ RESOUT2), disable EEPROM ( $\sim$ DISEEP), A0 data bit (A0OUT), and 16-bit data select ( $\sim$ IO16E). An interrupt input ( $\sim$ IREQ2) from the Function 2 controller is also supported.

Address inputs (HA0-HA15) and bi-directional data bus lines (HD0-HD7) 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 ( $\sim$ IORD), host write ( $\sim$ IOWR), chip select ( $\sim$ CE2), and I/O channel ready (IOCHRDY) signals connect directly from the PC Card Connector to the Function 2 controller.]

## Hardware Interfaces

### NVRAM (Serial EEPROM) Interface

A 2-line serial interface to an optional, non-volatile RAM is supported. The interface signals are a bi-directional 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 operation. A 2048-byte NVRAM can also store the 512-byte CIS table (optional). The CIS table can be changed by downloading the modified CIS information to the NVRAM.

### External Bus Interface

The non-multiplexed external bus supports eight bi-directional data lines (D0-D7) and 10 address output lines (A0-A9). Read enable output ( $\sim$ READ) and write enable output ( $\sim$ WRITE) lines are also supported.

## Telephone Line Interface

**L5502-11 PCMCIA BIF.** Wireline operation is selected when a DAA interface is indicated on the DAA/CELL input or when a cellular interface is indicated on the DAA/CELL input but no analog cellular driver is loaded.

Relay control outputs to the line interface are supported:

- $\sim$ RLY1: Off-hook ( $\sim$ OH) ( $\sim$ RLY1)
- $\sim$ RLY2: Voice ( $\sim$ VOICE) or Pulse ( $\sim$ PULSE)
- $\sim$ RLY3: Mute ( $\sim$ MUTE)
- $\sim$ RLY4: Caller ID ( $\sim$ CALLID) if needed. The DAAs shown in Figure 2 and Figure 3 support the Caller ID function without use of a separate relay.

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

**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

**L5502-11 PCMCIA BIF.** Analog cellular operation is selected when a cellular interface is indicated on the DAA/CELL input and a cellular driver is loaded. Signals supported are two encoded control outputs (CTRL0 and CTRL1), a bi-directional serial data line (CELDATA), a data clock input (CELCLK), a cellular busy output (CELBSY), and a cellular busy input ( $\sim$ CELBSY).

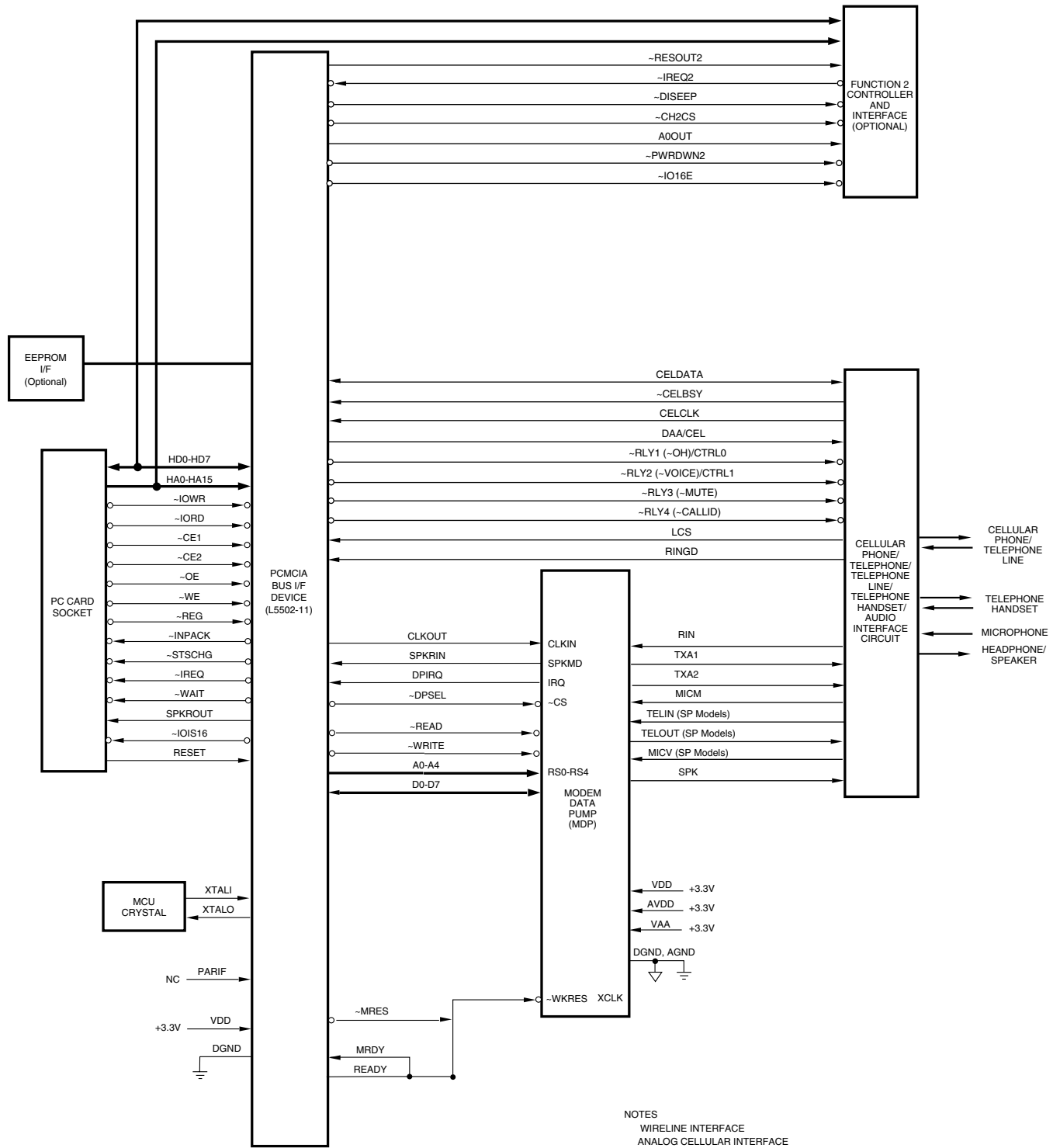
**MDP.** A single-ended receive analog input (RIN) and a differential transmit analog output (TXA1 and TXA2) are supported.

### Speakerphone Interface (S Models)

Microphone input (MICV) and a speaker output (SPKM) lines connect to handset, headset, or a microphone and speaker to support functions such as 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. These lines connect voice record/playback and audio to the local handset.





1223f-4 HIF PC Card

Figure 4. Hardware Interface Signals



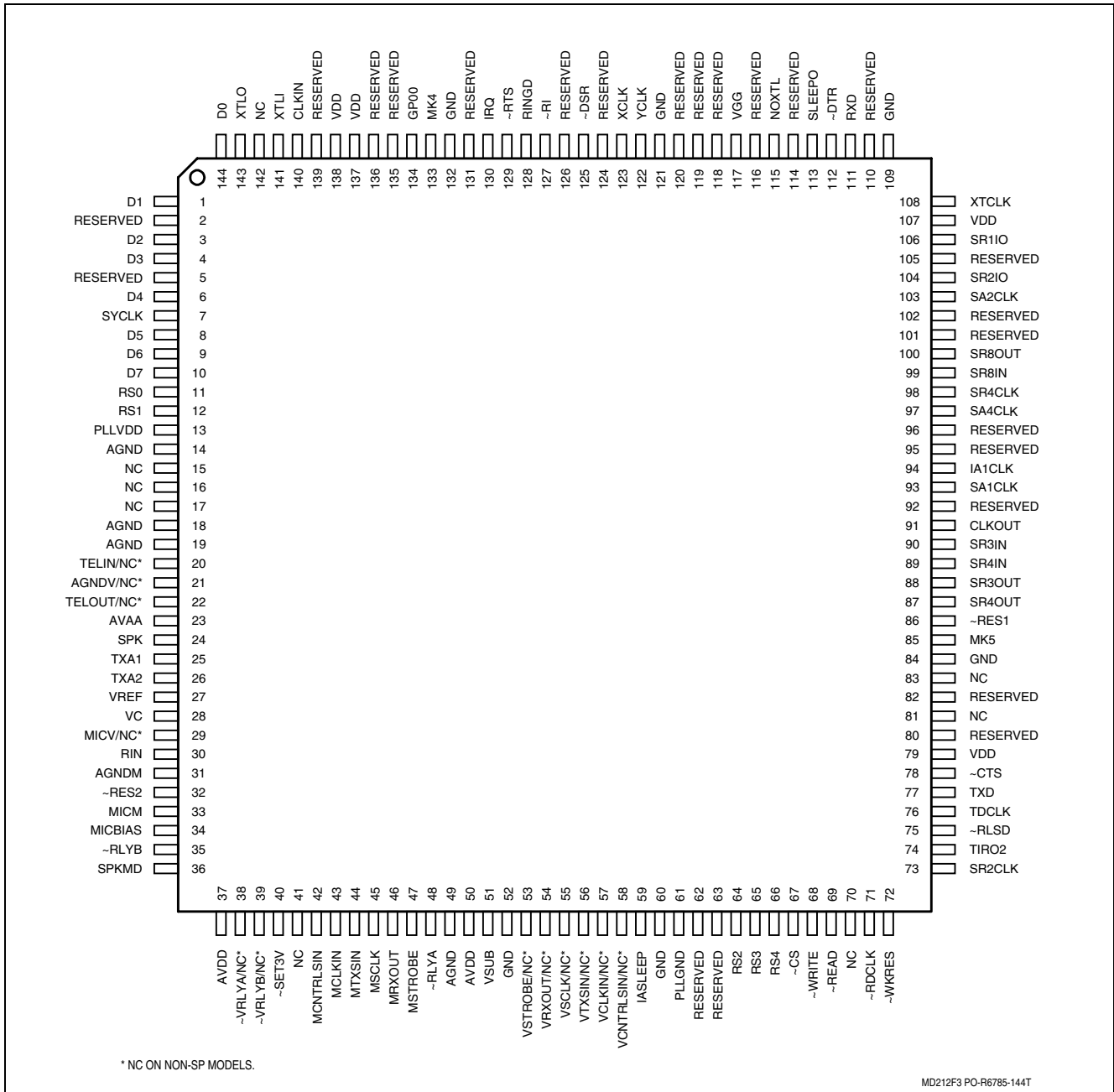


Figure 6. MDP (R6785-xx) Pin Signals - 144-Pin TQFP

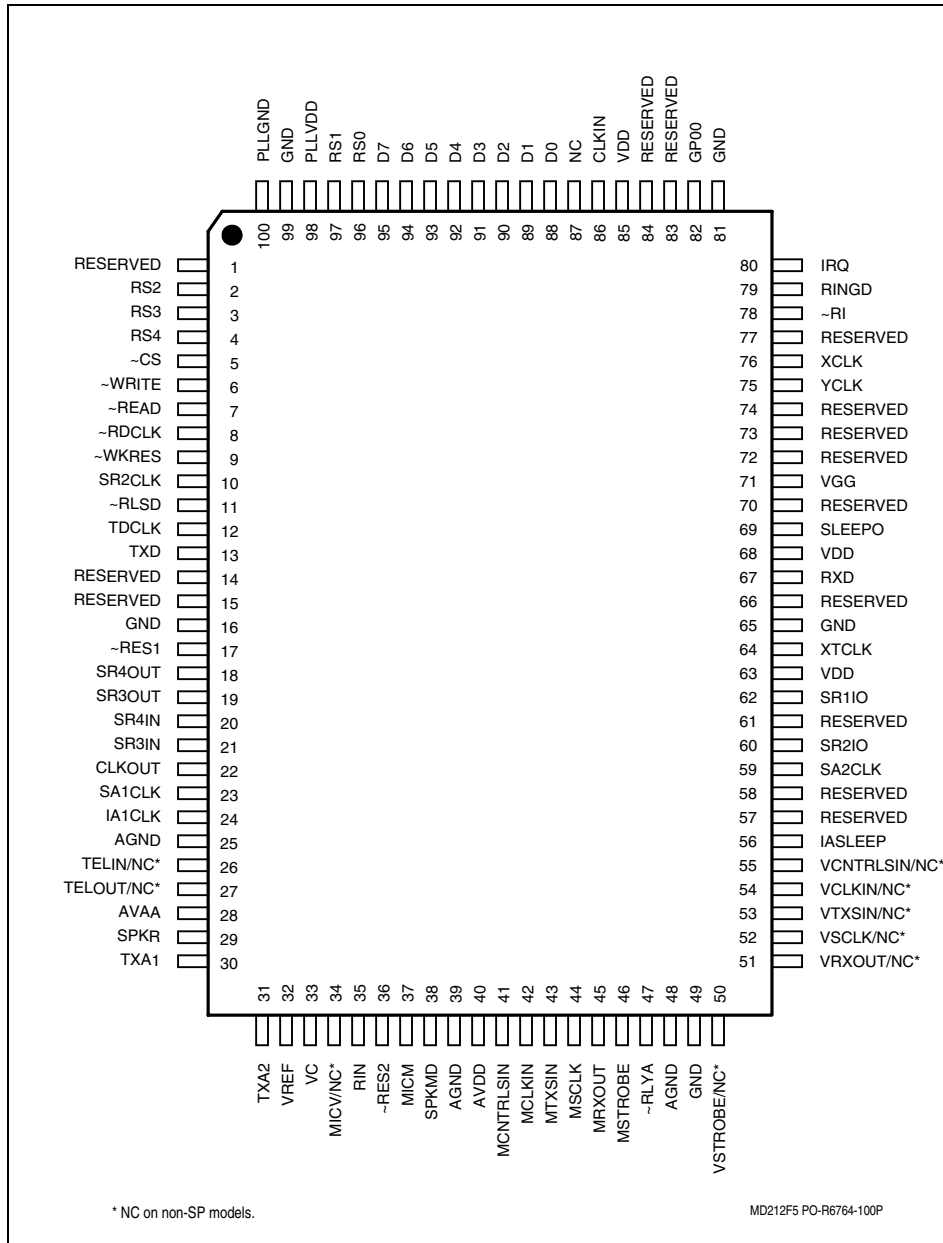


Figure 7. MDP (R6764-xx) Pin Signals - 100-Pin PQFP

## Electrical and Environmental Specifications

**Table 2. Current and Power Requirements**

Mode	Current (ID)		Power (PD)		Notes
	Typical Current (mA)	Maximum Current (mA)	Typical Power (mW)	Maximum Power (mW)	
L5502-11 PCMCIA BIF					$f_{IN} = 28.224 \text{ MHz}$
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	—	

**Notes:**

1. Test conditions: L5502-11 PCMCIA BIF and MDP: VCC = +3.3 VDC for typical values; VCC = +3.6 VDC for maximum values
2. Operating Voltage: L5502-11 PCMCIA BIF and MDP: +3.3V ± 0.3V
3. Input Ripple: ≤ 0.1 V<sub>peak-peak</sub>.
4. 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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