Rockwell Semiconductor Systems

SocketModem™

Designer's Guide (Preliminary)

Order No. 1009
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Patented

NOTICE

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1. INTRODUCTION

1.1 SUMMARY

The Rockwell SocketModem™ family of pin-compatible data/fax/voice/audio modem engines provides the OEM with a complete V.34/V.17, V.32bis/V.17 or V.22bis/V.29 modem in a compact socket-mountable module.

Several models of the SocketModem are available from Low Speed (V.22bis/V.29) to High Speed (V.34/V.17) + Voice configurations. These models supply varying functional capabilities, from inexpensive 2400 bps data/9600 bps fax modems, to 33,600 bps data/14,400 bps fax/AudioSpan/FDSP/voice/Audio modems with built-in data-compression and error-correction, while maintaining the same basic pinout interface.

The compact size and high level of integration of the SocketModem minimizes real estate and cost for motherboard and box modem applications. Its low power consumption makes it ideal for portable applications such as pocket modems or laptop, notebook and palmtop computers, and for a wide variety of embedded control applications. Plus, the pin compatibility between the full range of SocketModems allows upgrading and production configurability without hardware changes.

This designer's guide describes the modem hardware. AT commands and S Registers are defined in the AT Command Reference Manual (Order No. 1048).

1.1.1 High Speed

As a data modem, the High Speed SocketModem operates at line speeds to 33,600 bps (SFV336ACFW/SP, SMV288ACW), or 14,400 bps (SMV144ACW/U). Error correction (V.42/MNP 2–4) and data compression (V.42bis/MNP 5) maximize data transfer integrity and boost average throughput up to 115,200 bps (SFV336ACFW/SP, SMV288ACW) or 57.6 kbps (SMV144ACW/U). The High Speed SocketModem also operates in non-error-correcting mode. AutoSync operation is standard.

As a fax modem, the High Speed SocketModem supports Group 3 send and receive rates up to 14400 bps and supports Class 1 and Class 2 protocols (SFV336ACFW/SP supports Class 1 only).

The High Speed SocketModem with Voice features (SFV336ACFW/SP, SMV288ACW, SMV144ACW/U) uses enhanced Adaptive Differential Pulse Coded Modulation (ADPCM) coding and decoding to support efficient digital storage of voice/audio using 2-bit or 4-bit per sample compression and decompression with a 7200 Hz sample rate. This mode also supports 8-bit monophonic audio encoding at 11.025 kHz or 7200 Hz. This mode supports digital telephone answering machine (DTAM), voice annotation, and audio recording and playback applications.

The SFV336ACFW/SP supports analog simultaneous audio/voice and data (AudioSpan) and full-duplex speakerphone (FDSP). AudioSpan operation supports data rates of 4.8 kbps in V.61 mode, 4.8 to 9.6 kbps in ML144 mode, or 4.8 to 14.4 kbps in ML288 mode. FDSP supports position independent, full-duplex speakerphone operation using an advanced algorithm that includes both acoustic and line echo cancellation.

PC-based “ConfigurACE™ II for Windows” software allows MCU firmware to be customized to application and country requirements.

1.1.2 Low Speed

As a data modem, the Low Speed SocketModem operates at line speeds to 2400 bps (SM96V24ACW/U, SM224ATF). Error correction (V.42/MNP 2–4) and data compression (V.42bis/MNP 5) maximize data transfer integrity and boost average throughput up to 9600 bps (SM96V24ACW/U). The Low Speed SocketModem also operates in non-error-correcting mode.

Fax modes, controlled by built-in Class 1 command interface (SM224ATF), or Class 1 and Class 2 interface (SM96V24ACW/U), provide Group 3 transmit functions up to 9600 bps and receive functions up to 4800 bps (SM224ATF), or 9600 bps (SM96V24ACW/U).

Full error correction (V.42 LAPM, MNP2–4) and data compression (V.42bis, MNP 5) capabilities are supported in the SM224ATF through the Rockwell Protocol Interface (RPI) and host communication software supporting the RPI. A list of communication software supporting the RPI can be obtained from your local Rockwell sales representative.

1.2 TECHNICAL OVERVIEW

1.2.1 SUPPORTED INTERFACES

The major hardware signal interfaces of the SocketModem are illustrated in Figure 1-1.

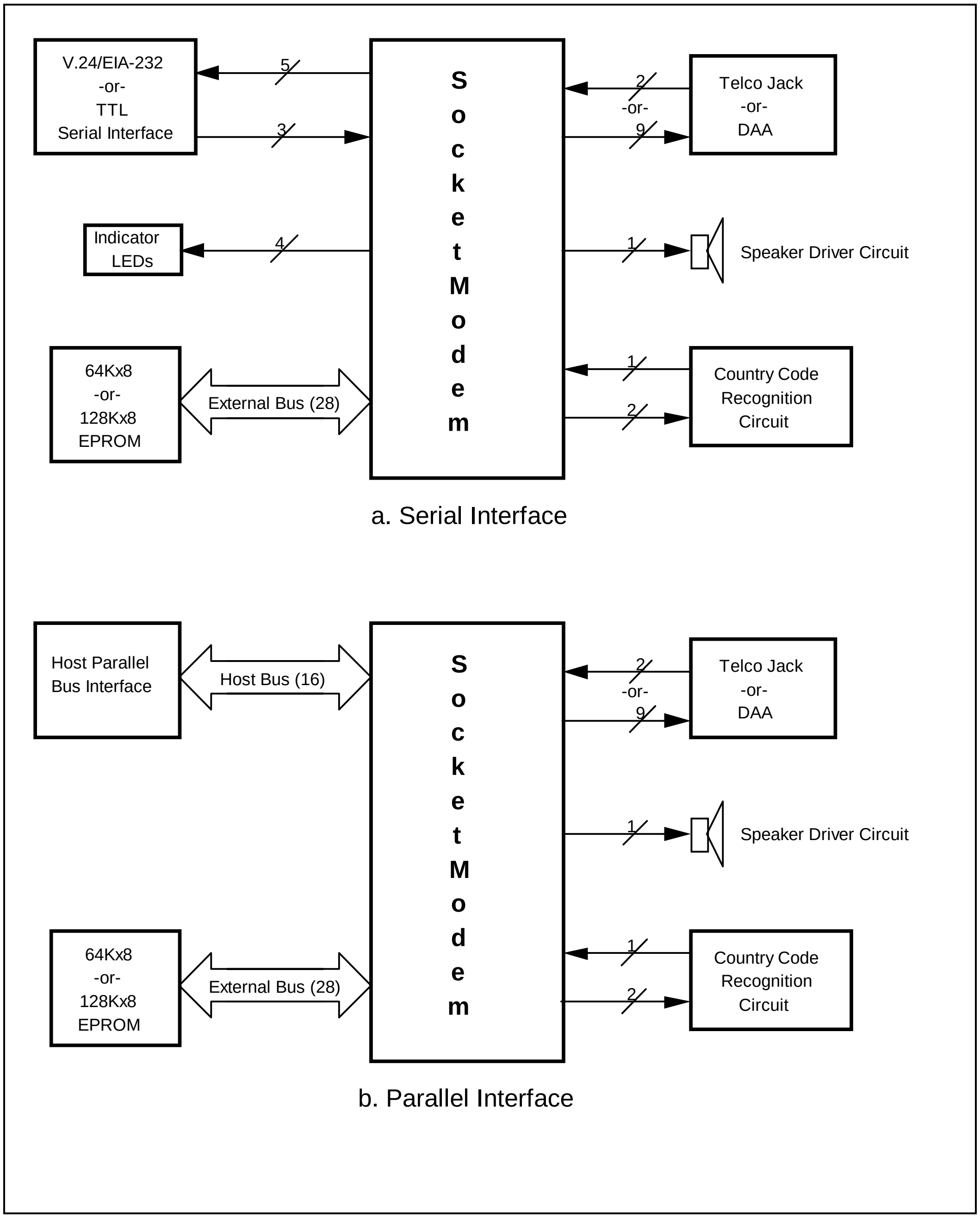

Figure 1-1. Typical Serial and Parallel Block Diagrams

Parallel Interface

A 16450 UART-compatible or 16550A UART-compatible parallel interface is provided. Eight data lines, three address lines, and five control lines are supported.

Serial/Indicator Interface

A DTE serial interface and indicator outputs are supported.

Serial Interface. A 9-line (8-line for SM224ATF) V.24/EIA-232 or TTL logic serial interface to the DTE is supported.

LED Indicator Interface. Four direct connect LED indicator outputs are supported.

Speaker Interface

A speaker output, controlled by AT commands, is provided for an optional OEM-supplied speaker circuit.

External Bus Interface

An external bus interface is provided (except SFV336ACFW/SP and SM224ATF) for OEM-supplied 128K/64K-byte ROM. The non-multiplexed bus supports eight bi-directional data lines and 17 address lines.

Line Interface

The SocketModem connects to the telephone network in one of two ways:

- Host-based Data Access Arrangement (DAA) (D0 option)
- SocketModem-based DAA (D4, D5, and D6 option)

In addition, two relay driver outputs are provided. The relay outputs may be used to drive Caller ID and voice relays (except SFV336ACFW/SP and SM224ATF).

The SocketModem (except SFV336ACFW/SP and SM224ATF) provides four relay control outputs to the line interface. These outputs may be used to control relays such as off-hook, pulse, mute, A/A1, earth, and talk/data for World-Class operation.

1.2.2 ConfigurACE™ UTILITY PROGRAM

The PC-based ConfigurACE II for Windows utility program allows the OEM to customize the modem firmware to suit specific application and country requirements. ConfigurACE II for Windows allows programming of functions such as:

- Loading of multiple sets of country parameters
- Loading of NVRAM factory profiles
- Call progress and blacklisting parameters
- Entry of S register maximum/minimum values
- Limitation of transmit levels
- Modification of factory default values
- Customization of the ATI4 response
- Customization of fax OEM messages

This program modifies the hex object code which can be programmed directly into the system EPROM. Lists of the generated parameters can be displayed or printed.

Rockwell-provided country parameter files allow a complete set of country-specific call progress and blacklisting parameters to be selected.

Refer to the ConfigurACE II for Windows software for a detailed description of capabilities and the operating procedure.

This program directly modifies the hex object code to be programmed directly into the SocketModem EPROM. Lists of the generated parameters can be displayed or printed.

Rockwell-provided country parameter files allow a complete set of country-specific call progress and blacklisting parameters to be selected.

Refer to the ConfigurACE II Utility Program User's Manual (Order No. 893) for a detailed description of capabilities and the operating procedure.

1.3 COMMAND SETS AND S REGISTERS

Modem operation is controlled by AT and S register commands issued by the DTE or, when using remote configuration, AT commands issued by the remote modem. The AT command sets differ among the SocketModem families. Refer to the *AT Command Reference Manual for the RCV336ACFx, RC288ACx and RC144ACx Modem Families* (Order No. 1048), *RCV336ACF/SP Modem Designer's Guide* (Order No. 1046), *RC288ACi and RC288ACL Modem Designer's Guide* (Order No. 1027), *RC144ACi and RC144ACL Modem Designer's Guide* (Order No. 876), *RC96V24AC and RC14V24AC Modem Designer's Guide* (Order No. 877), and the *RC224AT 2400 bps Single Device Modem with 'AT' Commands Designer's Guide* (Order No. 845) for details.

2. HARDWARE INTERFACE

2.1 INTERFACE SIGNALS

The SocketModem pin assignments with standard DTE serial TTL interface are shown in Figure 2-1 and are listed in Table 2-1.

The SocketModem pin assignments with standard DTE serial EIA-232 interface are shown in Figure 2-2 and are listed in Table 2-2.

The SocketModem pin assignments with standard host parallel interface are shown in Figure 2-3 and are listed in Table 2-3.

The SFV336ACFW/SP SocketModem pin assignments with DTE serial TTL interface are shown in Figure 2-4 and are listed in Table 2-4.

The SFV336ACFW/SP SocketModem pin assignments with DTE serial EIA-232 interface are shown in Figure 2-5 and are listed in Table 2-5

The SFV336ACFW/SP SocketModem pin assignments with host parallel interface are shown in Figure 2-6 and are listed in Table 2-6.

The SFV336ACFW/SP SocketModem DAA and Audio pinouts are shown in Figure 2-7.

2.1.1 Standard DTE Serial TTL Interface

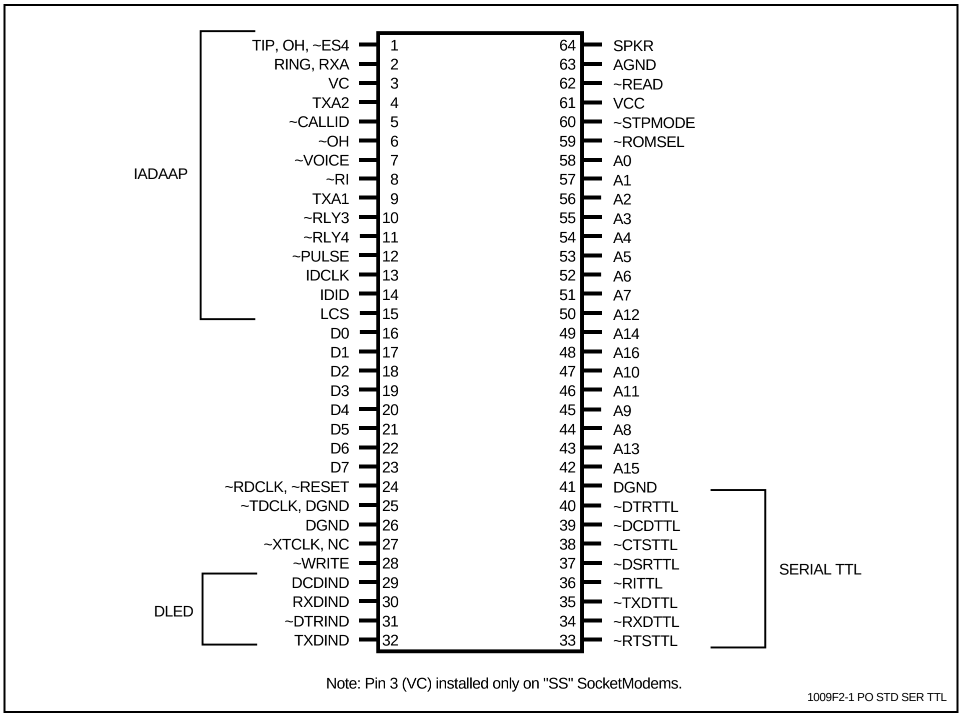

Figure 2-1. Standard DTE Serial TTL Pinout

Table 2-1. Standard DTE Serial TTL Signals

Pin	Signal	I/O Type	Pin	Signal	I/O Type
1	TIP, OH, ~ES4	In, Out, Out	33	~RTSTTL	Input
2	RING, RXA	Input, Output	34	~RXDTTL	Output
3	VC	Out (SS only)	35	~TXDTTL	Input
4	TXA2	Output	36	~RITTL	Output
5	~CALLID	Output	37	~DSRTTL	Output
6	~OH	Output	38	~CTSTTL	Output
7	~VOICE	Output	39	~DCDTTL	Output
8	~RI	Input, Output	40	~DTRTTL	Input
9	TXA1	Output	41	DGND	GND
10	~RLY3	Output	42	A15	Output
11	~RLY4	Output	43	A13	Output
12	~PULSE	Output	44	A8	Output
13	IDCLK	Output	45	A9	Output
14	IDID	Input	46	A11	Output
15	LCS	Input	47	A10	Output
16	D0	Input, Output	48	A16	Output
17	D1	Input, Output	49	A14	Output
18	D2	Input, Output	50	A12	Output
19	D3	Input, Output	51	A7	Output
20	D4	Input, Output	52	A6	Output
21	D5	Input, Output	53	A5	Output
22	D6	Input, Output	54	A4	Output
23	D7	Input, Output	55	A3	Output
24	~RDCLK, ~RESET	Output, Input	56	A2	Output
25	~TDCLK, DGND	Output, GND	57	A1	Output
26	DGND	GND	58	A0	Output
27	~XTCLK, NC	Input, -	59	~ROMSEL	Output
28	~WRITE	Output	60	~STPMODE	Input
29	DCDIND	Output	61	VCC	PWR
30	RXDIND	Output	62	~READ	Output
31	~DTRIND	Output	63	AGND	GND
32	TXDIND	Output	64	SPKR	Output

2.1.2 Standard DTE Serial EIA-232 Interface

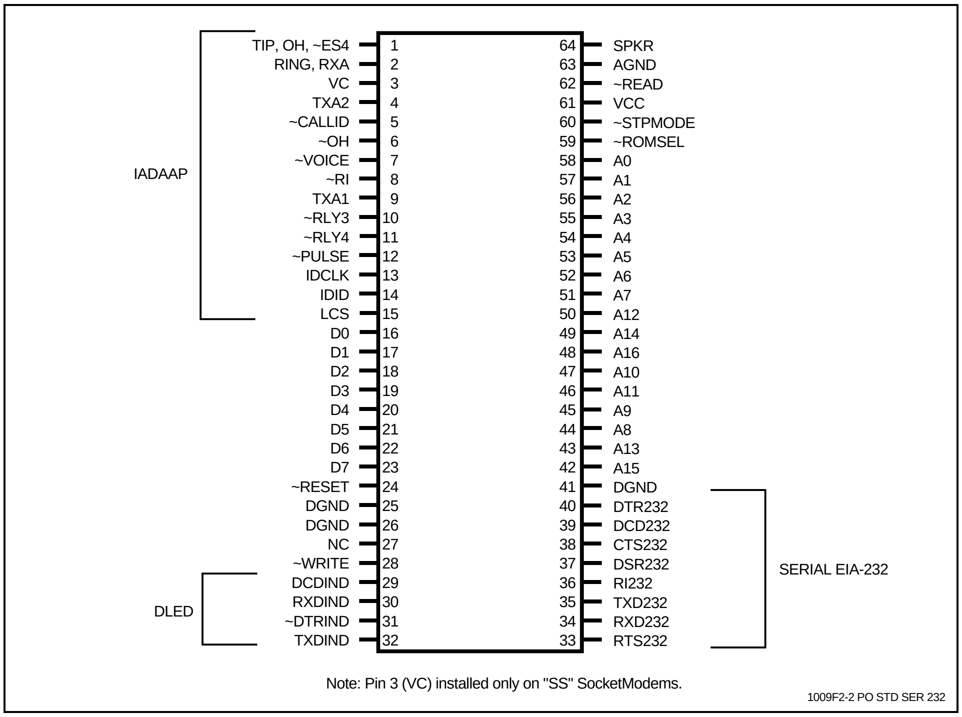

Figure 2-2. Standard DTE Serial EIA-232 Pinout

Table 2-2. Standard DTE Serial EIA-232 Signals

Pin	Signal	I/O Type	Pin	Signal	I/O Type
1	TIP, OH, ~ES4	In, Out, Out	33	RTS232	Input
2	RING, RXA	Input, Output	34	RXD232	Output
3	VC	Out (SS only)	35	TXD232	Input
4	TXA2	Output	36	RI232	Output
5	~CALLID	Output	37	DSR232	Output
6	~OH	Output	38	CTS232	Output
7	~VOICE	Output	39	DCD232	Output
8	~RI	Input, Output	40	DTR232	Input
9	TXA1	Output	41	DGND	GND
10	~RLY3	Output	42	A15	Output
11	~RLY4	Output	43	A13	Output
12	~PULSE	Output	44	A8	Output
13	IDCLK	Output	45	A9	Output
14	IDID	Input	46	A11	Output
15	LCS	Input	47	A10	Output
16	D0	Input, Output	48	A16	Output
17	D1	Input, Output	49	A14	Output
18	D2	Input, Output	50	A12	Output
19	D3	Input, Output	51	A7	Output
20	D4	Input, Output	52	A6	Output
21	D5	Input, Output	53	A5	Output
22	D6	Input, Output	54	A4	Output
23	D7	Input, Output	55	A3	Output
24	~RESET	Input	56	A2	Output
25	DGND	GND	57	A1	Output
26	DGND	GND	58	A0	Output
27	NC		59	~ROMSEL	Output
28	~WRITE	Output	60	~STPMODE	Input
29	DCDIND	Output	61	VCC	PWR
30	RXDIND	Output	62	~READ	Output
31	~DTRIND	Output	63	AGND	GND
32	TXDIND	Output	64	SPKR	Output

2.1.3 Standard Host Parallel Bus Interface

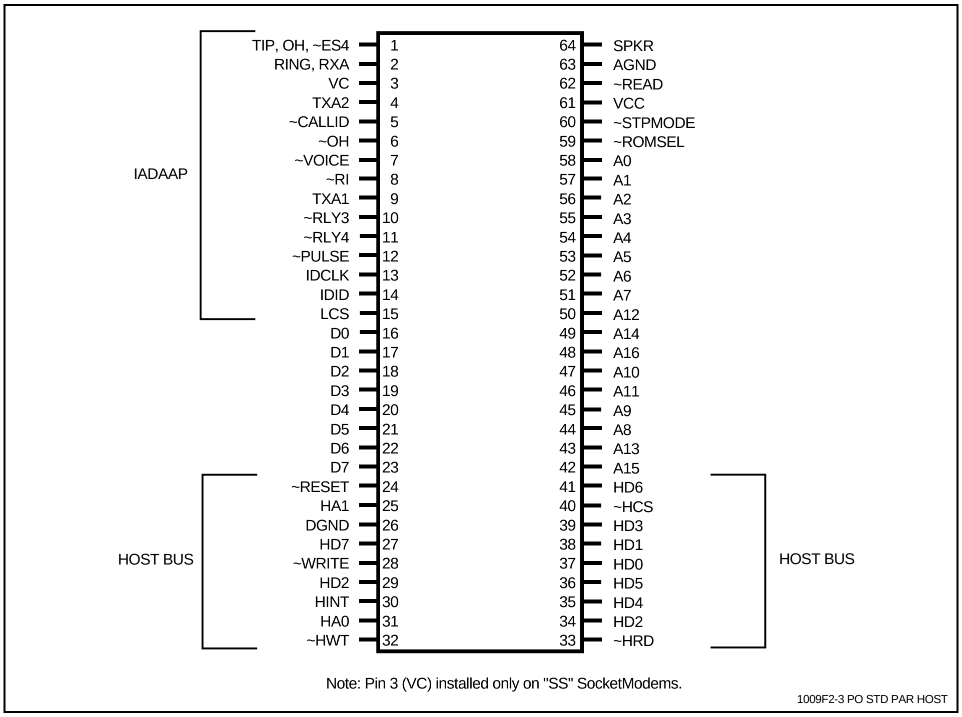

Figure 2-3. Standard Host Parallel Pinout

Table 2-3. Standard Host Parallel Signals

Pin	Signal	I/O Type	Pin	Signal	I/O Type
1	TIP, OH, ~ES4	In, Out, Out	33	~HRD	Input
2	RING, RXA	Input, Output	34	HA2	Input
3	VC	Out (SS only)	35	HD4	Input, Output
4	TXA2	Output	36	HD5	Input, Output
5	~CALLID	Output	37	HD0	Input, Output
6	~OH	Output	38	HD1	Input, Output
7	~VOICE	Output	39	HD3	Input, Output
8	~RI	Input, Output	40	~HCS	Input
9	TXA1	Output	41	HD6	Input, Output
10	~RLY3	Output	42	A15	Output
11	~RLY4	Output	43	A13	Output
12	~PULSE	Output	44	A8	Output
13	IDCLK	Output	45	A9	Output
14	IDID	Input	46	A11	Output
15	LCS	Input	47	A10	Output
16	D0	Input, Output	48	A16	Output
17	D1	Input, Output	49	A14	Output
18	D2	Input, Output	50	A12	Output
19	D3	Input, Output	51	A7	Output
20	D4	Input, Output	52	A6	Output
21	D5	Input, Output	53	A5	Output
22	D6	Input, Output	54	A4	Output
23	D7	Input, Output	55	A3	Output
24	~RESET	Input	56	A2	Output
25	HA1	Input	57	A1	Output
26	DGND	GND	58	A0	Output
27	HD7	Input, Output	59	~ROMSEL	Output
28	~WRITE	Output	60	~STPMODE	Input
29	HD2	Input, Output	61	VCC	PWR
30	HINT	Output	62	~READ	Output
31	HA0	Input	63	AGND	GND
32	~HWT	Input	64	SPKR	Output

2.1.4 SFV336ACFW/SP Interface

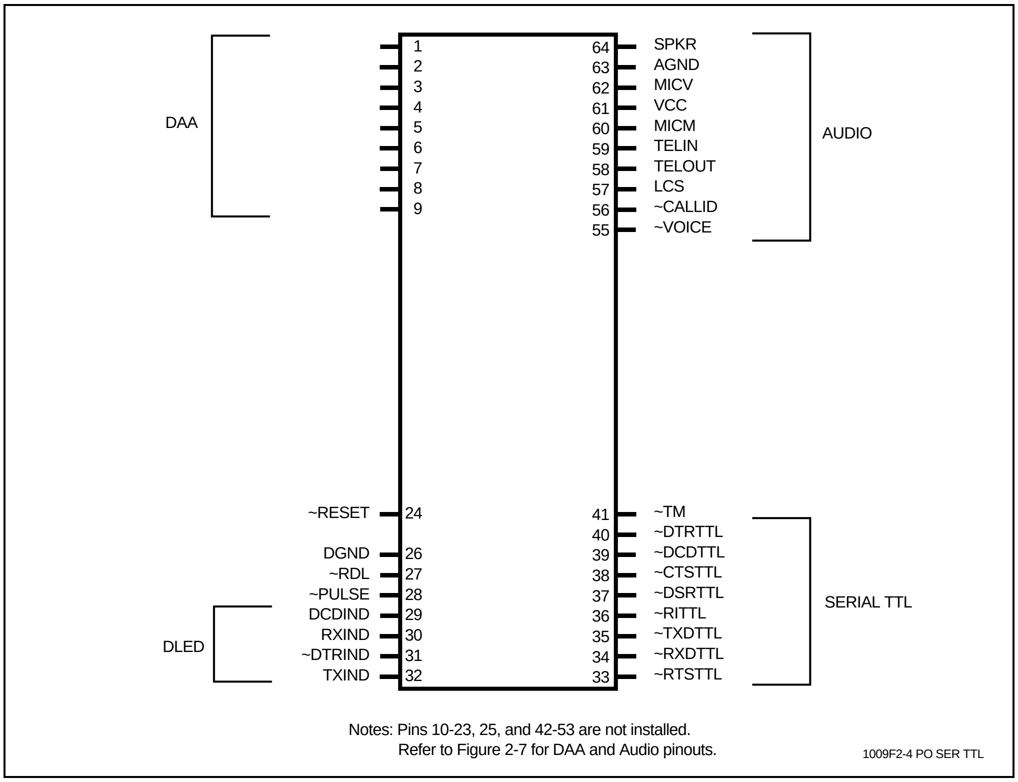

Figure 2-4. SFV336ACFW/SP DTE Serial TTL Pinout

Table 2-4. SFV336ACFW/SP DTE Serial TTL Signals

Pin	Signal	I/O Type	Pin	Signal	I/O Type
1	TIP, NC	I/O	33	~RTSTTL	Input
2	RING, ~OH	I/O, Output	34	~RXDTTL	Output
3	no pin, RDETIN1, NC	Input	35	~TXDTTL	Input
4	no pin, RDETIN2, RINGD	Input, Input	36	~RITTL	Output
5	no pin, ACOUT1, no pin	I/O	37	~DSRTTL	Output
6	no pin, ACOUT2, NC	I/O	38	~CTSTTL	Output
7	no pin, XFMR1, TXA1	I/O, Output	39	~DCDTTL	Output
8	no pin, XFMR2, TXA2	I/O, Output	40	~DTRTTL	Input
9	no pin, RDET/CID, RXA	Input, Input	41	~TM	Output
10	no pin		42	no pin	
11	no pin		43	no pin	
12	no pin		44	no pin	
13	no pin		45	no pin	
14	no pin		46	no pin	
15	no pin		47	no pin	
16	no pin		48	no pin	
17	no pin		49	no pin	
18	no pin		50	no pin	
19	no pin		51	no pin	
20	no pin		52	no pin	
21	no pin		53	no pin	
22	no pin		54	no pin, VC	Input
23	no pin		55	~VOICE	Output
24	~RESET	Output	56	~CALLID	Output
25	no pin		57	LCS	Input
26	DGND	GND	58	TELOUT	Output
27	~RDL	Input	59	TELIN	Input
28	~PULSE	Output	60	MICM	Input
29	DCDIND	Output	61	VCC	PWR
30	RXIND	Output	62	MICV	Input
31	~DTRIND	Output	63	AGND	GND
32	TXIND	Output	64	SPKR	Output

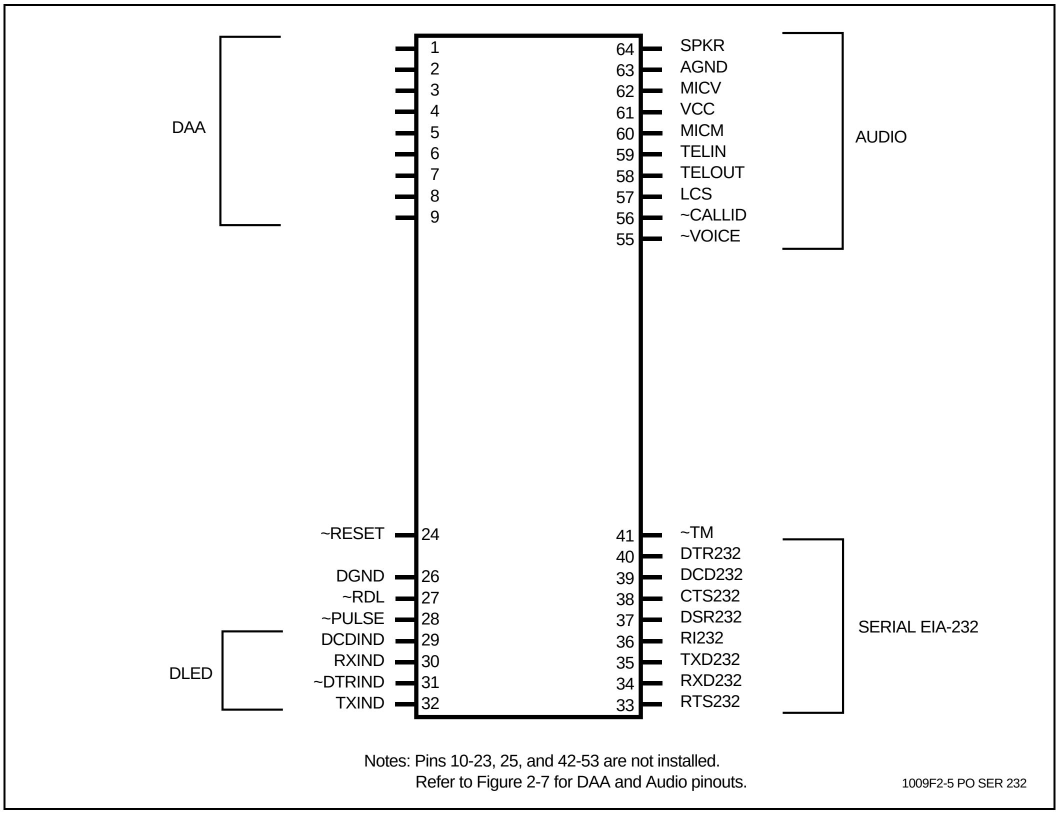

Figure 2-5. SFV336ACFW/SP DTE Serial EIA-232 Pinout

Table 2-5. SFV336ACFW/SP DTE Serial EIA-232 Signals

Pin	Signal	I/O Type	Pin	Signal	I/O Type
1	TIP, NC	I/O	33	RTS232	Input
2	RING, ~OH	I/O, Output	34	RXD232	Output
3	no pin, RDETIN1, NC	Input	35	TXD232	Input
4	no pin, RDETIN2, RINGD	Input, Input	36	RI232	Output
5	no pin, ACOUT1, no pin	I/O	37	DSR232	Output
6	no pin, ACOUT2, NC	I/O	38	CTS232	Output
7	no pin, XFMR1, TXA1	I/O, Output	39	DCD232	Output
8	no pin, XFMR2, TXA2	I/O, Output	40	DTR232	Input
9	no pin, RDET/CID, RXA	Input, Input	41	~TM	Output
10	no pin		42	no pin	
11	no pin		43	no pin	
12	no pin		44	no pin	
13	no pin		45	no pin	
14	no pin		46	no pin	
15	no pin		47	no pin	
16	no pin		48	no pin	
17	no pin		49	no pin	
18	no pin		50	no pin	
19	no pin		51	no pin	
20	no pin		52	no pin	
21	no pin		53	no pin	
22	no pin		54	no pin, VC	Input
23	no pin		55	~VOICE	Output
24	~RESET	Output	56	~CALLID	Output
25	no pin		57	LCS	Input
26	DGND	GND	58	TELOUT	Output
27	~RDL	Input	59	TELIN	Input
28	~PULSE	Output	60	MICM	Input
29	DCDIND	Output	61	VCC	PWR
30	RXIND	Output	62	MICV	Input
31	~DTRIND	Output	63	AGND	GND
32	TXIND	Output	64	SPKR	Output

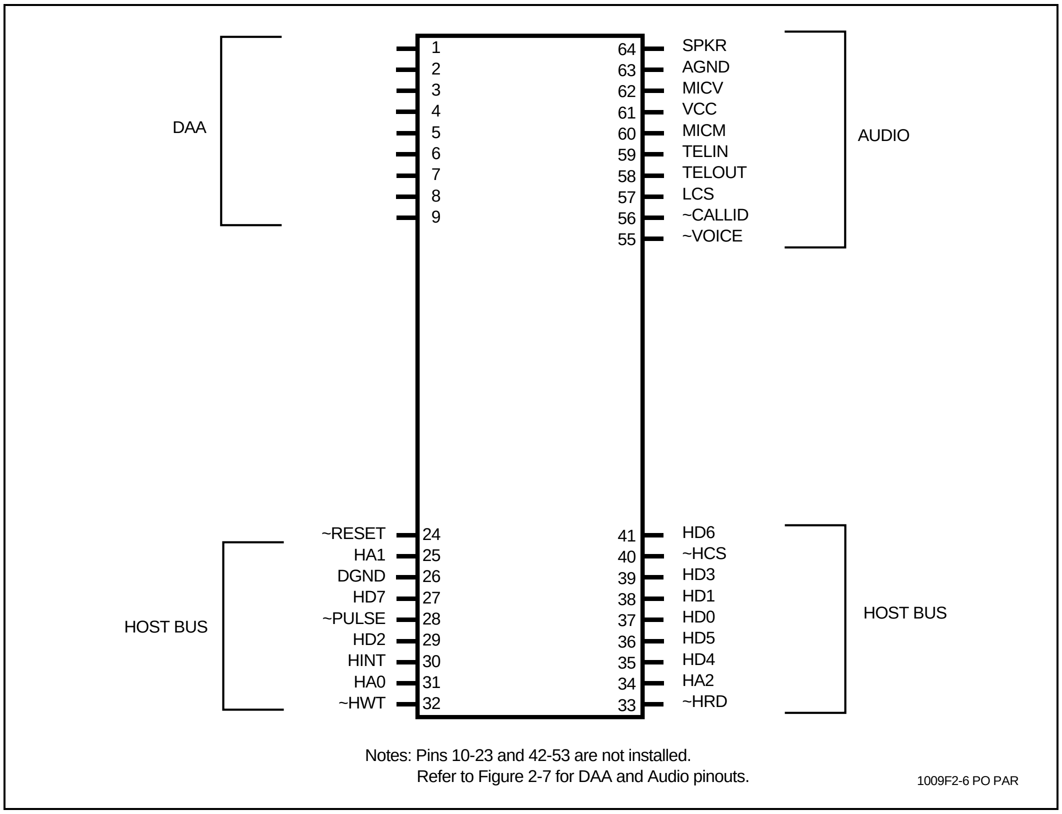

Figure 2-6. SFV336ACFW/SP Host Parallel Pinout

Table 2-6. SFV336ACFW/SP Host Parallel Signals

Pin	Signal	I/O Type	Pin	Signal	I/O Type
1	TIP, NC	I/O	33	~HRD	Input
2	RING, ~OH	I/O, Output	34	HA2	Input
3	no pin, RDETIN1, NC	Input	35	HD4	I/O
4	no pin, RDETIN2, RINGD	Input, Input	36	HD5	I/O
5	no pin, ACOUT1, no pin	I/O	37	HD0	I/O
6	no pin, ACOUT2, NC	I/O	38	HD1	I/O
7	no pin, XFMR1, TXA1	I/O, Output	39	HD3	I/O
8	no pin, XFMR2, TXA2	I/O, Output	40	~HCS	Input
9	no pin, RDET/CID, RXA	Input, Input	41	HD6	I/O
10	no pin		42	no pin	
11	no pin		43	no pin	
12	no pin		44	no pin	
13	no pin		45	no pin	
14	no pin		46	no pin	
15	no pin		47	no pin	
16	no pin		48	no pin	
17	no pin		49	no pin	
18	no pin		50	no pin	
19	no pin		51	no pin	
20	no pin		52	no pin	
21	no pin		53	no pin	
22	no pin		54	no pin, VC	Input
23	no pin		55	~VOICE	Output
24	~RESET	Input	56	~CALLID	Output
25	HA1	Input	57	LCS	Input
26	DGND	GND	58	TELOUT	Output
27	HD7	I/O	59	TELIN	Input
28	~PULSE	Output	60	MICM	Input
29	HD2	I/O	61	VCC	PWR
30	HINT	Output	62	MICV	Input
31	HA0	Input	63	AGND	GND
32	~HWT	Input	64	SPKR	Output

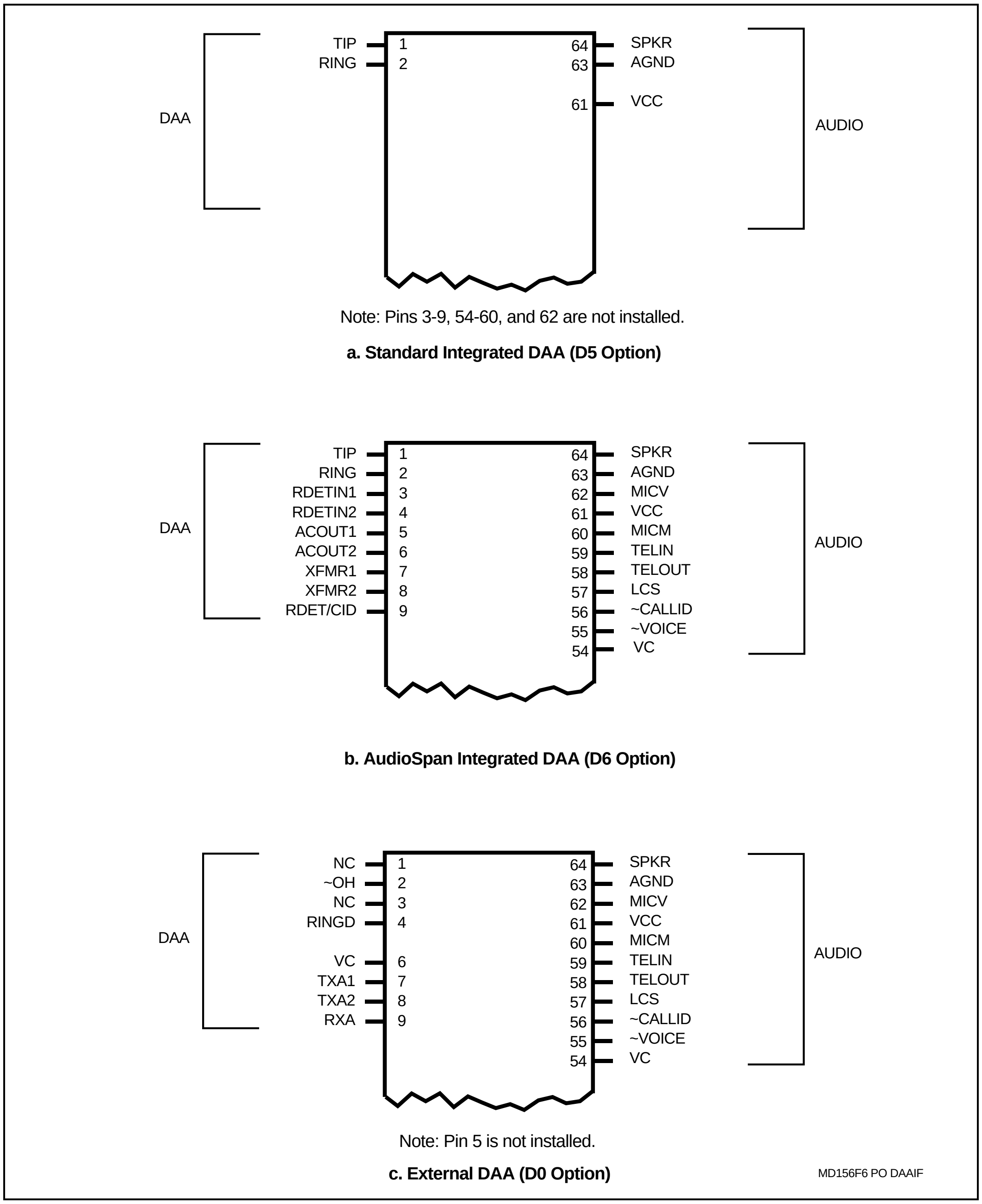

Figure 2-7. SFV336ACFW/SP DAA and Audio Pinouts

Table 2-7. Signal Descriptions

Label	I/O Type	Signal Name /Description
VCC	PWR	**+5VDC**
DGND	GND	**Digital Ground.** Connect to Digital Ground on the interface circuit.
~RESET	IA	**Modem Reset.** The Active Low ~RESET input resets the SocketModem logic and returns the AT command set to the original factory default values and to "stored values" in NVRAM. ~RESET on SocketModem serial models should not be connected externally; ~RESET is connected to a built-in reset circuit on the SocketModem.
AGND	GND	**Analog Ground.** Connect to Analog Ground on the interface circuit. Note that AGND is connected to DGND on the SocketModem.
TIP, OH, ~ES4	IA, OA, OA	**TIP Signal From Telco/PTT.** If an on-board DAA is used, this pin is TIP signal from the Telco jack. **OH.** If external DAA is used, this pin is the NANDed combination of ~OH and ~PULSE. **~ES4.** External Data Pump chip-select (for SS SocketModems only).
RING, RXA	IF, I(DA)	**RING Signal From Telco/PTT.** If an on-board DAA is used, this pin is RING signal from the Telco jack. **RXA Signal from DAA.** If external DAA is used, this pin is the RXA analog receive signal.
TXA2	O(DD)	**TXA2.** If an external DAA circuit is used, this pin is TXA2. The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other.
TXA1	O(DD)	**TXA1.** The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other.
~CALLID	OD	**Caller ID Relay Control.** Typically, the ~CALLID output is connected to the normally closed Caller ID relay (DPDT). When Caller ID is enabled, the modem will assert this output to open the Caller ID relay and close the Off-hook relay in order to detect Caller ID information between the first and second rings.
~OH	OA	**~OH Relay Control.** The active low ~OH output can be used to control the normally open off-hook relay. In this case, ~OH active closes the relay and connects the modem to the line (off-hook).
~VOICE	OA	**Voice Relay Control.** Typically, the ~VOICE output is connected to the normally open Voice relay (DPDT). In voice mode, ~VOICE active closes the relay to switch the handset from the telephone line to a current source to power the handset so it can be used as a microphone and speaker interface to the modem. The ~CALLID and ~VOICE output can each directly drive a +5V reed relay coil with a minimum resistance of 360Ω and having a must-operate voltage of no greater than 4.0 Vdc. A clamp diode, such as a 1N4148, should be installed across the relay coil. An external transistor, such as an MPSA20, can be used to drive heavier loads (e.g., electro-mechanical relays).
~PULSE	OA	**~PULSE Relay Control.** The active low ~PULSE output can be used to control the normally-open pulse dial relay. In this case, ~PULSE active closes the relay to effect loop disconnect (pulse) dialing. When a country recognition code circuit is used (see Section 3.3.3), the ~PULSE output is typically connected to the 74HC165 shift register SH/LD input. SFV336ACFW/SP only: ~PULSE relay control can be enabled using ConfigurACE II for Windows. Use the low-pass filter circuit shown in Figure 2-12 to prevent the NVRAM Data signal from toggling the ~PULSE relay (refer to the *RCV336ACF/SP Designer's Guide* for details).
~RLY3	OA	**Relay 3 Control (~MUTE, ~A-A1).** The active low ~RLY3 output can be used to control the normally-open mute relay or the normally open key telephone hold indicator (A-A1) relay. When configured to control the mute relay, ~MUTE active closes the normally open relay during dialing so that the loop disconnect (pulse) dialing is between an open and short circuit. When configured to control the A/A1 relay, ~A-A1 active closes the normally open relay when the modem is connected to the line.

Table 2-5. Signal Descriptions (Cont'd)

Label	I/O Type	Signal Name /Description
~RLY4	OA	**Relay 4 Control (~EARTH, ~T-DRLY).** The active low ~RLY4 output can be used to control the normally-open earthing (EARTH) relay or the normally closed talk/data (T-DRLY) relay. When configured to control the earth connection (EARTH) relay, in response to encountering the ">>" dial modifier in a dial string, ~EARTH active closes a relay used to ground a signal on the telephone connector. This signal is used in some countries to instruct a PBX to request an external line. When configured to control the T-DRLY relay, ~T-DRLY active closes the normally closed relay.
LCS	IA	**Line Current Sense.** When enabled, the LCS input indicates whether the associated handset is off-hook (high) or on-hook (low). Bit 4 in Option Flags 1 must be set using ConfigurACE to enable LCS operation.
IDCLK	OA	**IDCLK.** Serial clock for World-Class DAA determination.
IDID	I/O	**IDID.** Serial data for World-Class DAA determination.
~RI	OA, IA	**Ring Indicate.** If an on-board DAA is used, ~RI is an active-low ring-indicator output. If an external DAA is used, ~RI is an active-low ring-indicator input.
~STPMODE	IA	**Stop Mode.** ~STPMODE is pulled high through a 10 KΩ resistor to prevent entry into Stop Mode. Stop Mode is not supported.
HA0-HA2	IA	**Host Bus Address Lines 0-2.** During a host read or write operation, HA0-HA2 select an internal 16C450- or 16C550-compatible register. The state of the divisor latch access bit (DLAB) affects the selection of certain registers.
HD0-HD7	I/O	**Host Bus Data Lines 0-7.** HD0-HD7 are comprised of eight three-state input/output lines providing bi-directional communication between the host and the SocketModem. Data, control words, and status information are transferred through HD0-HD7.
~HCS	IA	**Host Bus Chip Select.** ~HCS input low selects the host bus.
~HRD	IA	**Host Bus Read.** ~HRD is an active low, read control input. When ~HCS is low, ~HRD low allows the host to read status information or data from a selected SocketModem register.
~HWT	IA	**Host Bus Write.** ~HWT is an active low, write control input. When ~HCS is low, ~HWT low allows the host to write data or control words into a selected SocketModem register.
HINT	OA	**Host Bus Interrupt.** HINT output is set high when the receiver error flag, received data available, transmitter holding register empty, or modem status interrupt has an active high condition. HINT is reset low upon the appropriate interrupt service or master reset operation.
The Serial interface signals are either TTL-level or EIA-232-level signals.		
~RTSTTL, RTS232	IA, IH	**Request To Send (TTL Active Low, EIA-232 Active High).** ~RTS is used to condition the local modem for data transmission and, during half-duplex operation, to control the direction of data transmission. On a full-duplex channel, RTS OFF maintains the modem in a non-transmit mode. A non-transmit mode does not imply that all line signals have been removed from the telephone line. RTS OFF may be ignored if the modem is optioned to strap ~CTS ON; this allows the modem to receive from the DTE even though RTS is OFF. RTS input ON causes the modem to transmit data on TXD when ~CTS becomes active.
~RXDTTL, RXD232	OA, OH	**Received Data (TTL Active Low, EIA-232 Active High).** The modem uses the ~RXD line to send data received from the telephone line to the DTE and to send modem responses to the DTE. During command mode, ~RXD data represents the modem responses to the DTE. Modem responses take priority over incoming data when the two signals are in competition for ~RXD.
~TXDTTL, TXD232	IA, IH	**Transmitted Data (TTL Active Low, EIA-232 Active High).** The DTE uses the ~TXD line to send data to the modem for transmission over the telephone line or to transmit commands to the modem. The DTE should hold this circuit in the mark state when no data is being transmitted or during intervals between characters.

Table 2-5. Signal Descriptions (Cont'd)

Label	I/O Type	Signal Name /Description
~CTSTTL, CTS232	OA, OH	**Clear To Send (TTL Active Low, EIA-232 Active High).** ~CTS is controlled by the modem to indicate whether or not the modem is ready to transmit data. ~CTS ON, together with the ~RTS ON, ~DSR ON, and ~DTR ON (where implemented), indicates to the DTE that signals presented on TXD will be transmitted to the telephone line. ~CTS OFF indicates to the DTE that it should not transfer data across the interface on TXD. ~CTS ON is a response to ~DTR ON and ~RTS, delayed as may be appropriate for the modem to establish a telephone connection. ~CTS output is controlled by the AT&Rn command.
~RITTL, RI232	OA, OH	**Ring Indicate (TTL Active Low, EIA-232 Active High).** ~RI output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line. The modem will not go off-hook when ~RI is active; the modem waits for ~RI to go inactive before going off-hook. For US models, ~RI will respond to ring signals in the frequency range of 15.3 Hz to 68 Hz. The ring signal cycle is typically two seconds ON, four seconds OFF. The OFF (high) condition of the ~RI input should be maintained during the OFF segment of the ring cycle (between rings) and at all other times when ringing is not being received.
~DSRTTL, DSR232	OA, OH	**Data Set Ready (TTL Active Low, EIA-232 Active High).** ~DSR indicates modem status to the DTE. ~DSR OFF (high) indicates that the DTE is to disregard all signals appearing on the interchange circuits except Ring Indicator (~RI). ~DSR output is controlled by the AT&Sn command. If the AT&S1 option is selected, ~DSR will come ON in the handshaking state when carrier is detected in the originate mode or when carrier is first sent in the answer mode. In addition, if a test mode is entered (AT&T1, AT&T3, AT&T6-AT&T8), ~DSR will go off while the test is running. ~DSR goes OFF if ~DTR goes OFF. If AT&Q0 and AT&S0 are selected, ~DSR will remain on at all times regardless of the modem's current state.
~DCDTTL, DCD232	OA, OH	**Data Carrier Detect (TTL Active Low, EIA-232 Active High).** When AT&C0 command is not in effect, ~DCD output is ON when a carrier is detected on the telephone line or OFF when carrier is not detected. ~DCD can be strapped ON using AT&C0 command.
~DTRTTL, DTR232	IA, IH	**Data Terminal Ready (TTL Active Low, EIA-232 Active High).** The ~DTR input is turned ON (low) by the DTE when the DTE is ready to transmit or receive data. ~DTR ON prepares the modem to be connected to the telephone line, and maintains the connection established by the DTE (manual answering) or internally (automatic answering). ~DTR OFF places the modem in the disconnect state under control of the &Dn and &Qn commands. The effect of ~DTR ON and ~DTR OFF depends on the &Dn and &Qn commands. Automatic answer is enabled when ~DTR is ON if the "Answer Ringcount" selectable option is not set to 0. Regardless of which device is driving ~DTR, the modem will respond to an incoming ring by going off-hook and beginning the handshake sequence. The response of the modem to the ~DTR signal is very slow (up to 10 ms) to prevent noise from falsely causing the modem to disconnect from the telephone line.
~RDCLK	OA	**Receive Data Clock.** In synchronous mode, the SocketModem outputs a synchronous Receive Data Clock for USRT timing (TTL SS SocketModems only.)
~TDCLK	OA	**Transmit Data Clock.** In synchronous mode, the SocketModem outputs a synchronous Transmit Data Clock for USRT timing (TTL SS SocketModems only.)
~XTCLK	IA	**External Transmit Clock.** In synchronous mode, an external transmit data clock can be connected to the ~XTCLK input (TTL SS SocketModems only.)
GND	GND	**Ground.**

Table 2-5. Signal Descriptions (Cont’d)

Label	I/O Type	Signal Name /Description
LED driver lines are open-drain inverter-driven (74HCT05) lines with 1.5 KΩ, 1/10W pull-up resistors.		
DCDIND	OG	**Active High DCD Status.**
RXDIND	OG	**Active High RXD Status.**
~DTRIND	OG	**Active Low DTR Status.**
TXDIND	OG	**Active High TXD Status.**
SPKR	O(DF)	**Speaker Analog Output.** The SPKR output reflects the received analog input signal. The SPKR is controlled by the ATMn command. SPKR is either a direct output from the data pump’s SPKR pin (SM224ATF, SM96V24ACW/U), or has a 1K Ω series resistor between the data pump’s SPKR pin and the SocketModem’s SPKR pin (SM144ACW/U, SMV288ACW) that can be used as an input to an external audio amplifier.
SIGNALS UNIQUE TO THE SFV336ACFW/SP		
~TM	OB	**Test Mode Indicate (EIA TM/ITU-T CT142).** The ~TM output indicates the modem is in test mode (low) or in any other mode (high).
RDETIN1, RDETIN2	IF	**Ring Detect Input.** RDETIN1 and RDETIN2 receive the TIP and RING signals from the telco jack. RDETIN1 and RDETIN2 are typically disconnected from TIP and RING during voice applications.
ACOUT1, ACOUT2	IO(DX)	**DAA Interface.** ACOUT1 and ACOUT2 connect to RDET/CID and RDETIN1 when ~CALLID is active. ACOUT1 and ACOUT2 connect to the XFMR1 and XFMR2 when ~CALLID is inactive.
XFRM1, XFRM2	IO(DX)	**DAA Interface.** XFRM1 and XFRM2 are tied directly to the primary windings of the on-board DAA transformer. XFRM1 and XFRM2 connect to RDET/CID and RDETIN1 when ~CALLID is active and to ACOUT1 and ACOUT2 when ~CALLID is inactive.
~RDL	IA	**Remote Digital Loop Select (EIA RL/CCITT CT140).** ~RDL input low activates remote digital loop request. The loop is executed at the speed for which the modem is currently configured. ~RDL is pulled up to VCC through a 10K Ω resistor on the SocketModem.
RINGD	IA	**Ring Frequency.** A rising edge on the RINGD input initiates an internal ring frequency measurement. The RINGD input is typically connected to the output of an optoisolator or equivalent. The idle state (no ringing) output of the ring detect circuit should be low.
Telephone Handset Interface		
TELIN	I(DA)	**Telephone Handset Input.** TELIN is supported in AudioSpan mode and is the input from the telephone handset microphone interface circuit.
TELOUT	O(DF)	**Telephone Handset Output.** TELOUT is supported in AudioSpan mode and is the output to the telephone handset speaker interface circuit.
Audio/Headset Interface		
MICM	I(DA)	**Microphone Modem Input.** MICM is a single-ended microphone input from the analog switch circuit. The input impedance is > 70k Ω.
MICV	I(DA)	**Microphone Voice Input.** MICV is a single-ended microphone input from the analog switch circuit. The input impedance is > 70k Ω.
SPKV	O(DF)	**Speaker Output.** SPKV is a single ended-output. SPKV is tied directly to the data pump’s SPKV pin.

Notes:

1. I/O types:
   - I(DA) = Analog input (see Table 2-9).
   - O(DD), O(DF) = Analog output (see Table 2-9).
   - IO (DX) = Analog input/output (see Table 2-9).

Table 2-8. Digital Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions[1]
Input High Voltage	V_{IH}				Vdc	
Type IA		2	–	VCC		
Type IC		0.7 VCC	–	VCC + 0.3		
Type ID		0.8 VCC	–	VCC + 0.3		
Type IH		-30		30		
Input Low Voltage	V_{IL}					
Type IA, IC, and ID		-0.3	–	0.8	Vdc	
Type IF		38	–	–	Vrms	
Input Leakage Current	I_{IN}				µADC	V_{IN} = 0 to VCC
RESET/		–	–	±2.5		
Output High Voltage	V_{OH}				Vdc	
Type OA		2.4	–	–		I_{LOAD} = – 100 µA
Type OD		–	–	VCC		I_{LOAD} = 0 mA
Type OG		–	–	VCC		
Type OH		5	8	–		
Output Low Voltage	V_{OL}				Vdc	
Type OA		–	–	0.4		I_{LOAD} = 1.6 mA
Type OB		–	–	0.4		I_{LOAD} = 0.8 mA
Type OD		–	0.75	–		I_{LOAD} = 15 mA
Type OG		0.5	–	–		I_{LOAD} = 8 mA
Type OH		-8	-5	–		
Three-State (Off) Current	I_{TSI}			±10	µADC	V_{IN} = 0 V
Circuit Type						
Type IA						TTL
Type IC						CMOS with pull-up
Type ID						~RES
Type IF						
Type OA						TTL with 3-state
Type OD						Relay driver
Type OG						
Type OH						

Notes:

1. Test Conditions: VCC = ±5%, TA = 0°C to 70°C,
   Output loads: Data bus (D0-D7), address bus (A0-A15), chip selects, ~READ, and ~WRITE loads = 70 pF + one TTL load.
   Other = 50 pF + one TTL load.

Table 2-9. Analog Electrical Characteristics

Name	Type	Characteristic	Value
RXA	I (DA)	Input Impedance AC Input Voltage Range Reference Voltage	> 70K Ω (Note 1, 2), > 50K Ω (Note 3) 1.1 VP-P +2.5 VDC
TELIN	I (DA)	Input Impedance AC Input Voltage Range Reference Voltage	> 70K Ω 1.1 VP-P +2.5 VDC
TXA1, TXA2, TELOUT	O (DD)	Minimum Load Maximum Capacitive Load Output Impedance AC Output Voltage Range Reference Voltage DC Offset Voltage	300 Ω 0 µF 10 Ω 2.2 VP-P +2.5 VDC ± 200 mV
SPKR, SPKV	O (DF)	Minimum Load Maximum Capacitive Load Output Impedance AC Output Voltage Range Reference Voltage DC Offset Voltage	300 Ω 0.01 µF 10 Ω 1.1 VP-P +2.5 VDC ± 20 mV
MICM, MICV	I (DA)	Input Impedance Maximum AC Input Voltage Reference Voltage Maximum AC Output Voltage	> 70K Ω 1.7 VP-P +2.5 VDC 2.7 VP-P
ACOUT1 ACOUT2 XFMR1 XFMR2	IO(DX)	AC Voltage Range AC Current Signal Strength	2.0 VP-P (Note 2) < 500 mA ≤ -9.5 dBm

Notes:

1. SMV144ACW/U
   SMV144AC/U
   SSV144AC/U
   SMV288ACW
   SSV288ACW
2. SFV336ACFW/SP
   SFV336ACF/SP
3. SM96V24ACW/U
   SM224ATF

2.1.5 Firmware ROM

SocketModem firmware performs processing of general modem control, command sets, error correction, data compression, MNP 10, fax Class 1 and Class 2, voice, audio, RPI, and DTE interface functions depending on the modem model. The SocketModem firmware is provided by Rockwell in object code form for the OEM to program into external ROM (except SM224ATF). The SFV336ACFW/SP SocketModem firmware is programmed into the on-board ROM by Rockwell. Models with on-board flash EEPROM may be reprogrammed via the flash-download process.

The ROM is either 64Kx8 or 128Kx8. Typical EPROMs are 27C512 for 64K code and 27C010 for 128K code. The ROM onboard the SFV336ACFW/SP is 128Kx8. Table 2-10 shows the capacities and speeds of the ROMs required by different SocketModems.

Figure 2-8 shows the standard SocketModem-to-ROM interface. This interface applies to all external-ROM SocketModems. The ~WRITE signal supports use of flash EPROMs.

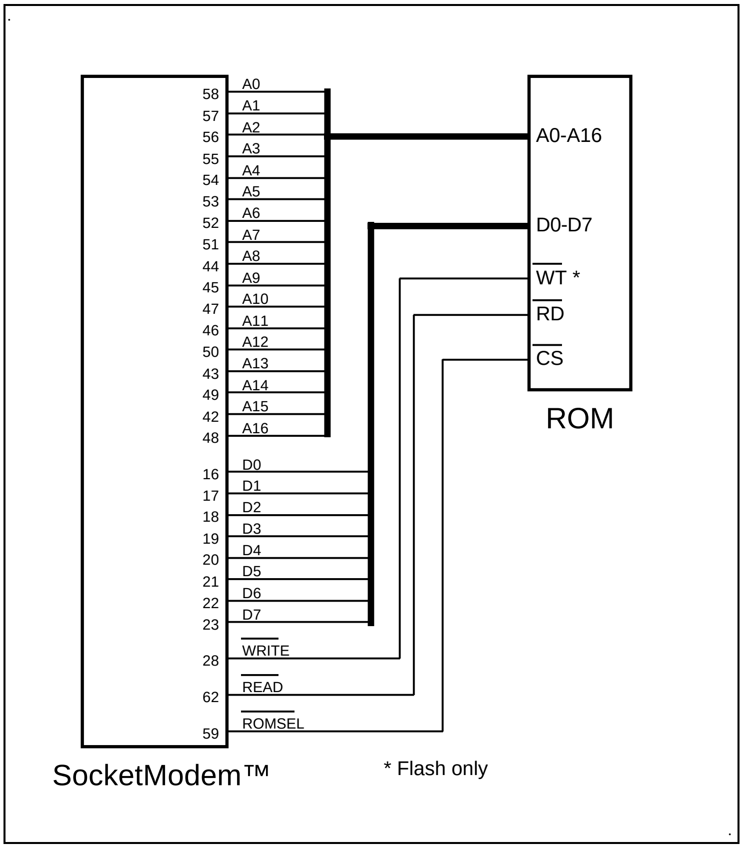

Figure 2-8. Interface to External ROM

Table 2-10. SocketModem ROM Size and Speed

SocketModem	Size	Speed
SM224ATF	N/A	N/A
SM96V24ACW/U	64Kx8 or 128Kx8	150 ns
SMV144ACW/U	128Kx8	70 ns
SSV144ACW/U	128Kx8	70 ns
SMV288ACW/U	128Kx8	45 ns
SSV288ACW/U	128Kx8	45 ns
SFV336ACFW/SP	128Kx8	N/A

2.1.6 DAA Interface

The SocketModem is configured for the DAA to be an on-board DAA (-D4, D5, or D6 option) or an external, off-board DAA (-D0 option).

When using the on-board DAA, provide the TIP and RING signals from the Telco jack to pins 1 and 2 of the SocketModem. Use the appropriate telco interface circuitry to meet the FCC/DOC requirements. An example of an on-board DAA design is shown in Figure 2-9.

A recommended design of an external DAA suitable for use in high-speed (V.34, V.32 bis) applications in the USA or Canada is shown in Figure 2-10. A recommended low-speed (V.22bis/V.29) DAA is shown in Figure 2-11. The telco interface is the standard TIP/RING pair of telephone signals. The SocketModem interface is comprised of RXA, TXA1, and TXA2 for the data signals, ~RI for the Ring Indicate input, and ~OH and ~PULSE as the Off-Hook and Pulse relay controls.

The choke and capacitors in Figure 2-9, C1, C2, L1, and L2 in Figure 2-10, and C1 and C2 in Figure 2-11 are used for EMI suppression only. These components may be removed for FCC part 68 testing.

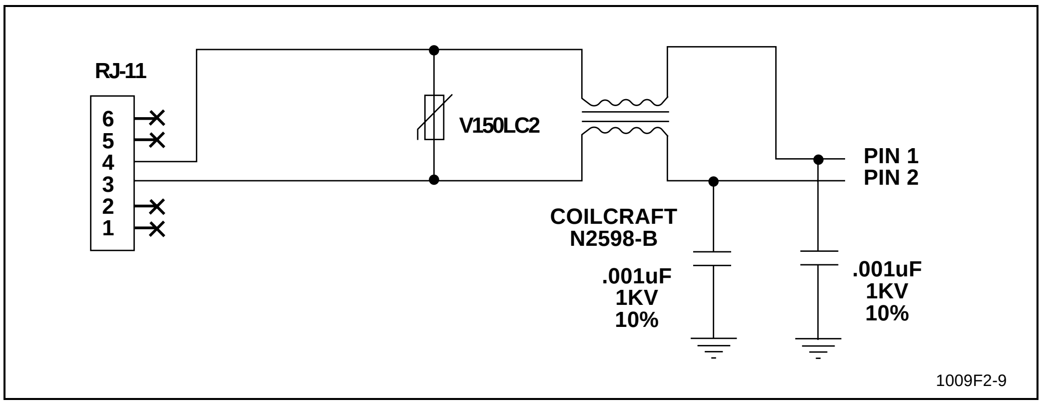

Figure 2-9. Example of DAA Interface for SocketModems with Self-Contained DAAs

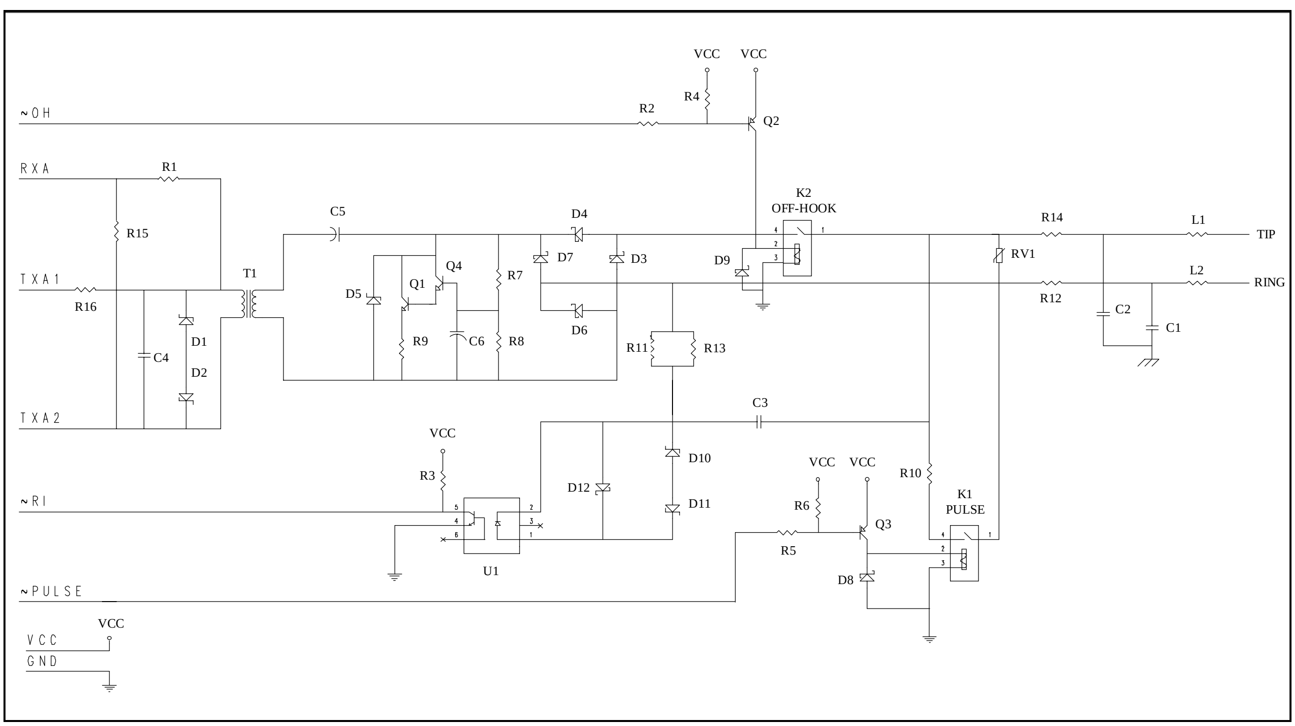

Figure 2-10. External High Speed DAA Example

Table 2-11. External High Speed DAA Bill of Materials

Quantity	Reference	Part
2	C1, C2	Capacitor, 1000pF, 10%, 1KV, Ceramic
1	C3	Capacitor, 0.47uF, 300V, Poly
1	C4	Capacitor, 1000pF, 20%, 50V, Ceramic
1	C5	Capacitor, 10uF, 10%, 16V, Tantalum
1	C6	Capacitor, 6.8uF, 10%, 16V, Electrolytic
2	D1, D2	Diode, MLL479A, 5%, 4.3V
7	D3, D4, D6, D7, D8, D9, D12	Diode, LL101A
3	D5, D10, D11	Diode, LL967AB, 5%, 18V, Zener
1	J1	Phone Jack, RJ-11
1	K1	Relay, Pulse
1	K2	Relay, Off-Hook
2	L1, L2	Ferrite Bead (as needed for EMI)
1	Q1	Transistor, 2N2102
2	Q2, Q3	Transistor, MMDT2907A
1	Q4	Transistor, MMBT2222
1	R1	Resistor, 523Ω, 1%, 1/8W, Film
1	R2	Resistor, 3.3KΩ, 5%, 1/8W, Carbon
1	R3	Resistor, 100KΩ, 5%, 1/8W, Carbon
2	R4, R6	Resistor, 27KΩ, 5%, 1/8W, Carbon
1	R5	Resistor, 4.7KΩ, 5%, 1/8W, Carbon
1	R7	Resistor, 40.2KΩ, 1%, 1/4W, Film
1	R8	Resistor, 18.7KΩ, 1%, 1/8W, Film
1	R9	Resistor, 10Ω, 1%, 1/8W
1	R10	Resistor, 120Ω, 1/2W
2	R11, R13	Resistor, 15KΩ, 5%, 1/4W
2	R12, R14	Resistor, 18Ω, 5%, 1/2W, 500V
1	R15	Resistor, 10.0KΩ, 1/8W
1	R16	Resistor, 5.23KΩ, 1/8W
1	RV1	Varistor, V250LC4, 250VRMS
1	T1	Transformer, Midcom 671-1538
1	U1	Optoisolator, 4N35

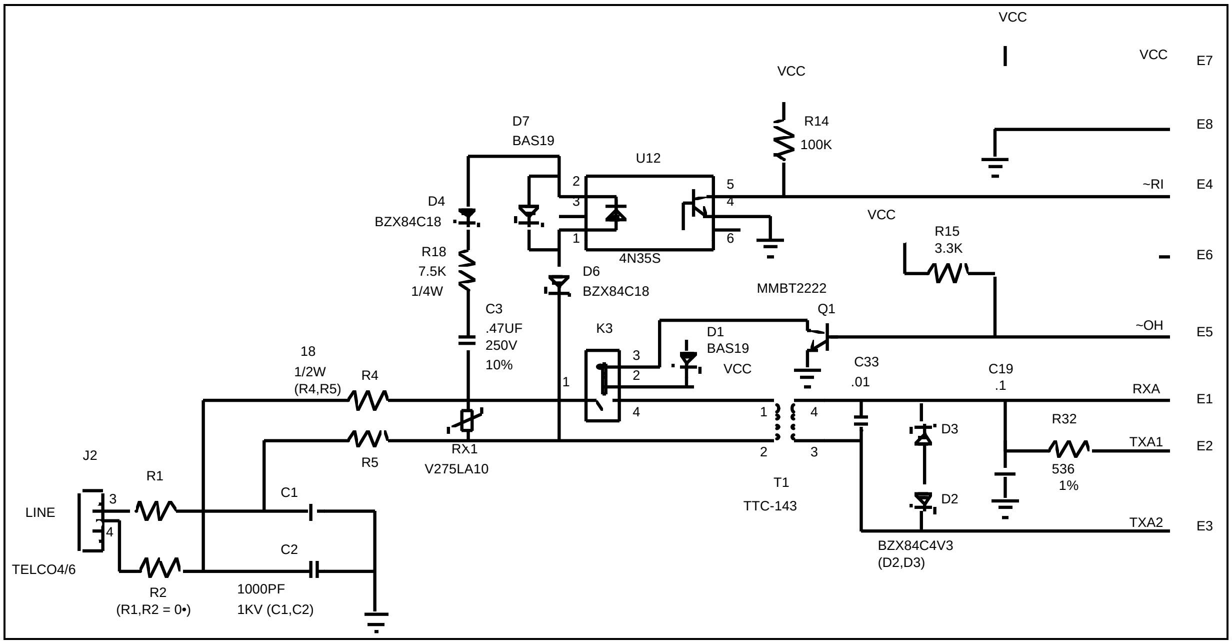

Figure 2-11. External Low Speed DAA Example

Table 2-12. External Low Speed DAA Bill of Materials

Quantity	Reference	Part
2	C1, C2	Capacitor, 1000pF, 1KV
1	C19	Capacitor, 0.1uF, 20%, 50V, Ceramic
1	C3	Capacitor, 0.47uF, 10%, 250V
1	C33	Capacitor, 0.01uF, 20%, 50V
2	D1, D7	Diode, BAS19
2	D2, D3	Diode, BZX84C4V3
2	D4, D6	Diode, BZX84C18, 18V
1	J2	Phone Jack, RJ-11
1	K3	Relay, Off-hook, Pulse
1	Q1	Transistor, MMBT2222
2	R1, R2	Resistor, 0Ω
2	R4, R5	Resistor, 18Ω, 5%, 1/2W
1	R14	Resistor, 100KΩ, 5%, 1/8W
1	R15	Resistor, 3.3KΩ, 5%, 1/8W
1	R18	Resistor, 7.5KΩ, 5%, 1/4W
1	R32	Resistor, 536Ω, 1%, 1/8W
1	RX1	Varistor, V275LA10
1	T1	Transformer. TTC-143
1	U12	Optoisolator, 4N35S

2.1.7 ~PULSE Filter Circuit

On the SFV336ACFW/SP SocketModem, the ~PULSE signal required for pulse dialing is available on pin 28 but must be connected to a low pass filter circuit. The circuit shown in Figure 2-12 shows one filter that satisfactorily filters the ~PULSE line from the ~PULSE relay. Refer to the *RCV336ACF/SP Modem Designer's Guide* for details.

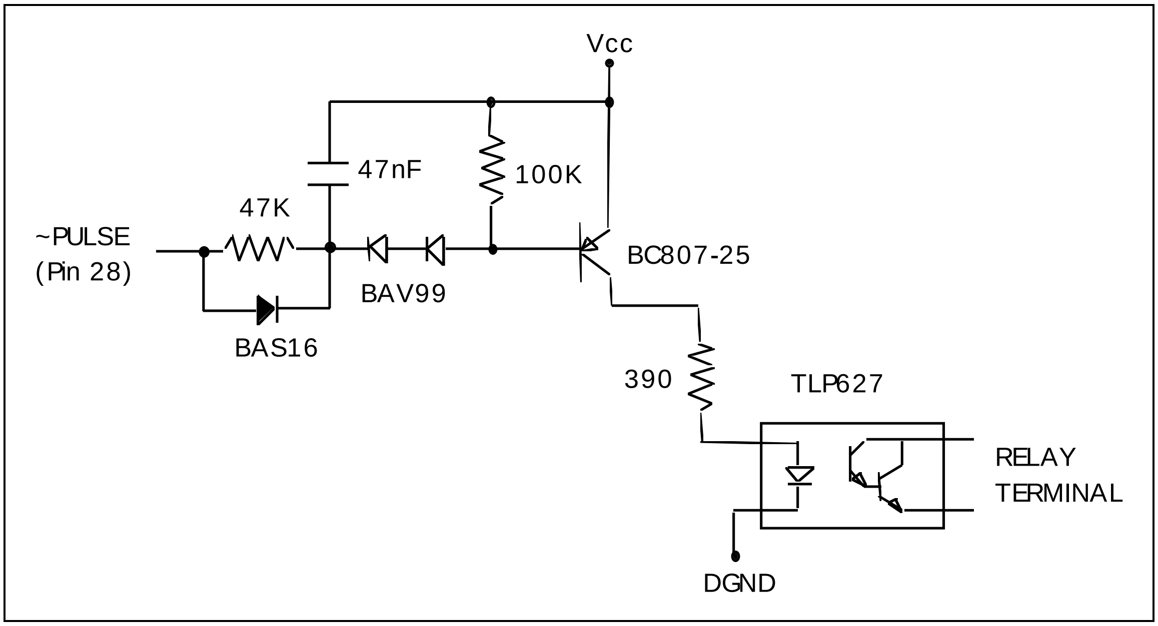

Figure 2-12. ~PULSE Filter Circuit

2.1.8 Audio Interface

Audio output is useful for monitoring the modem's call-progress tones and modem system debugging, as well as for full-featured Voice and Business Audio applications. The two audio amplifier circuits shown below are similar in layout but differ in audio quality. The Sounducer circuit is suitable for basic call-progress-tone monitoring, while the speaker circuit is appropriate for Voice applications.

In Figure 2-13, the audio amplifier drives a piezo-electric Sounducer. The SPKR signal from the SocketModem is fed into a non-inverting op amp. The 10 µF capacitor between pin 1 and pin 8 of the op amp bypasses internal circuitry to achieve the maximum gain. The second 10 µF capacitor, between pin 5 of the op amp and the Sounducer, is used to keep the 2.5 VDC bias of the op amp from going into the Sounducer.

In Figure 2-14, the audio amplifier drives a 50Ω speaker. In this circuit, the op amp's bypass circuit includes a 750 Ω resistor, and the bias-blocking capacitor changes to 220 µF.

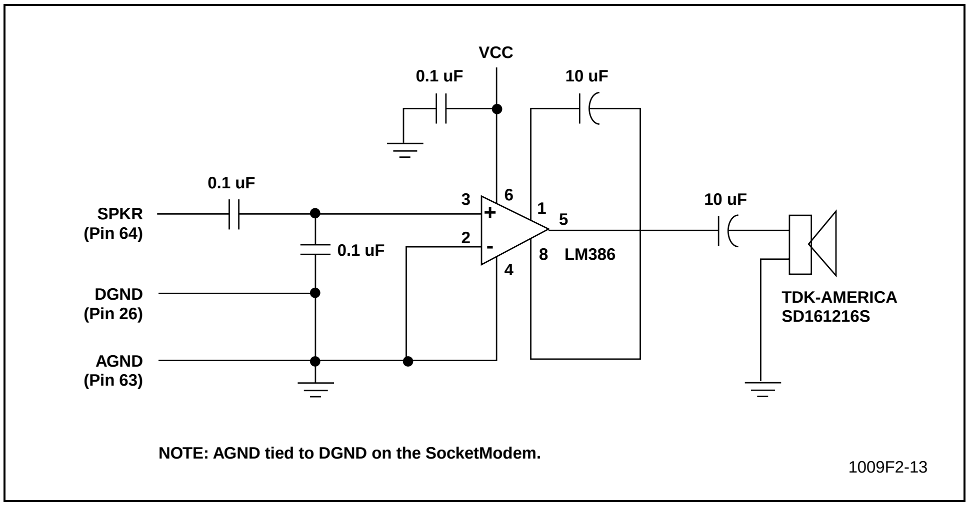

Figure 2-13. Sounducer Driver Circuit

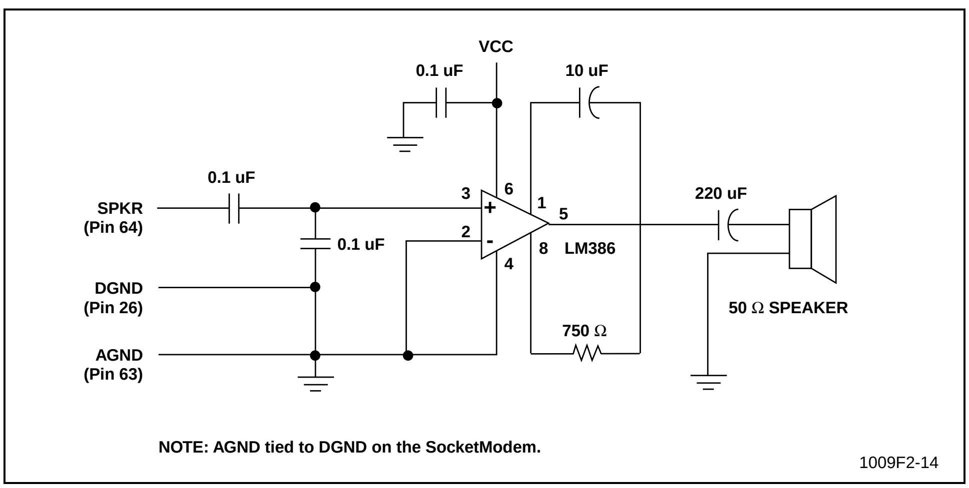

Figure 2-14. Speaker Driver Circuit

2.1.9 SFV336ACFW/SP Telephone Line/Telephone/Audio Interface

The drawings shown in Figure 2-15, Figure 2-16, and Figure 2-17 describe a typical full-featured SFV336ACF/SP DAA circuit implementing all the audio features available on the SFV336ACF/SP SocketModem. Figure 2-15 outlines the complete DAA circuit for the SFV336ACF/SP configured for the -D6 DAA interface. Figure 2-16 and Figure 2-17 describe the DAA + audio circuit used on the TE28-D400 and TE28-D500 SocketModem Evaluation Boards.

The basic DAA portion of the circuit starts with the TXA1 and TXA2 differential-output signals from the RCV336ACF/SP modem chip, and the RIN single-ended analog input. These signals are impedance-matched to the secondary windings of the transformer on the SocketModem.

The primary windings of the transformer are routed out to the SocketModem pins XFMR1 and XFMR2 (Pins 7 and 8), where they are connected to the inputs of a DPDT relay controlled by ~CALLID. During normal operation, and when Caller ID is disabled, XFMR1 and XFMR1 are connected back to the SocketModem on pins ACOUT1 and ACOUT2 (Pins 5 and 6). ACOUT1 and ACOUT2 connect to a full-wave bridge and current-holding circuit, the output of which goes to TIP and RING (Pins 1 and 2), after the RING signal is routed through the ~OH (off-hook) relay. The off-hook relay is activated when the modem wants to seize the phone line to either place a call or answer an in-coming call. TIP and RING connect to the phone jack through a pair of 18.2Ω resistors and across a 250 VRMS circuit-protecting varistor. The two 1000 pF capacitors and the Fair-Rite ferrite-bead inductor connected to each RJ-11 phone jack are used for EMI protection only. Depending on how the circuit board is laid out, these three parts may not even be needed, but places for them should be included so that they may be included at assembly time should EMI test results call for them. If the ferrite beads are not needed, install the two zero Ω resistors (jumpers) instead for each phone jack.

If Caller ID is enabled, ~CALLID is activated between the first and second rings of an incoming call and XFMR1 and XFMR2 are routed instead to the RDETIN1 and RDET/CID pins (Pins 3 and 9). XFMR1 is connected to RDETIN1, which is connected to pin 4 of the Voice relay, and out through pin 3 of the Voice relay to the TIP signal from telephone line. Likewise, XFMR2 is connected to RDET/CID, goes through a 0.33 µF capacitor on the SocketModem which performs DC-blocking, goes off the SocketModem again through RDETIN2 (Pin 4) and over to pin 9 of the Voice relay, then out through pin 10 of the relay to the RING signal from the phone jack. This circuit completes the TIP/RING-to-XFMR1/XFMR2 connection, using the 0.33 µF capacitor normally used by the ring-detect circuit to provide DC-blocking while preventing the drawing of current sufficient to seize the line.

Detection of an incoming ring signal is performed by routing Tip and Ring from the phone-line jack through pins 4 and 9 of the normal-state Voice relay, connecting Tip to RDETIN1, and Ring to RDETIN2 (Pins 3 and 4). The ring signal is then rectified and fed into an opto-isolator, which sends the detected ring signal as a TTL-level waveform to the RINGD pin of the RCV336ACF/SP device.

When a user picks up the handset of a phone plugged into the local-phone jack, current flows from the Tip signal on the phone-line RJ-11 jack through pin 4 of the Voice relay, through the IL250 opto-isolator and through the local phone, then out through pin 9 of the Voice relay and out to the Ring signal of the phone-line jack. This current through the IL250 opto-isolator activates the LCS (Line Current Sense) signal sent to the RCV336ACF/SP, which may then enable or disable certain modem features depending on its run-time configuration.

The Voice relay, controlled by the ~VOICE signal from the RCV336ACF/SP, is used to provide current, generated by the LM317LM current-source, to power a phone plugged into the local-phone jack, and to connect the local phone to the TELIN (pin 59) and TELOUT (pin 58) signals. TELIN receives audio signals from the local handset's microphone, and TELOUT transmits audio signals to the handset's speaker. ~VOICE is typically activated when the user wants to record and/or listen to voice prompts from a phone plugged into the modem's local-phone jack.

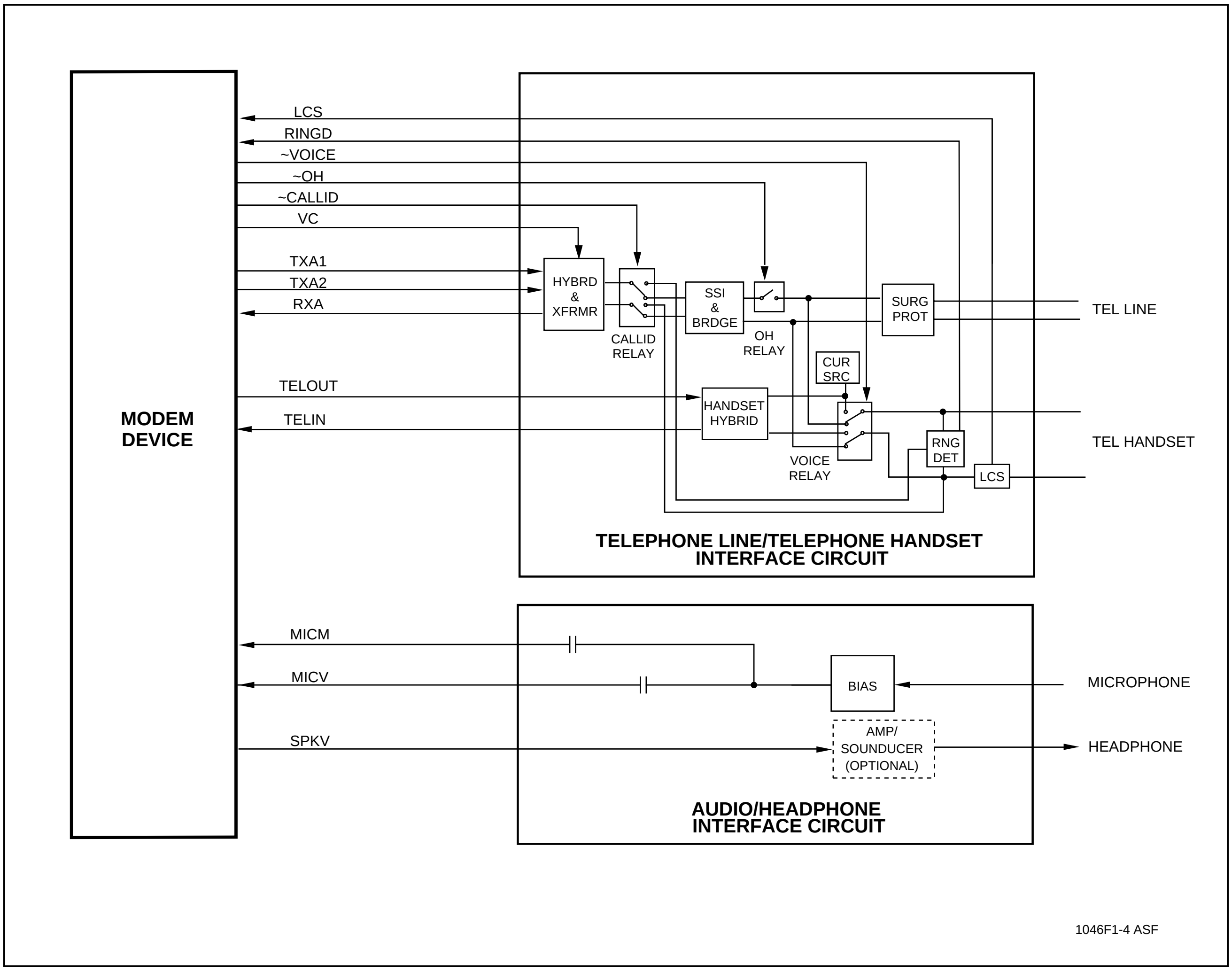

Figure 2-15. SFV336ACF/SP Telephone Line/Telephone/Audio Interface Circuit

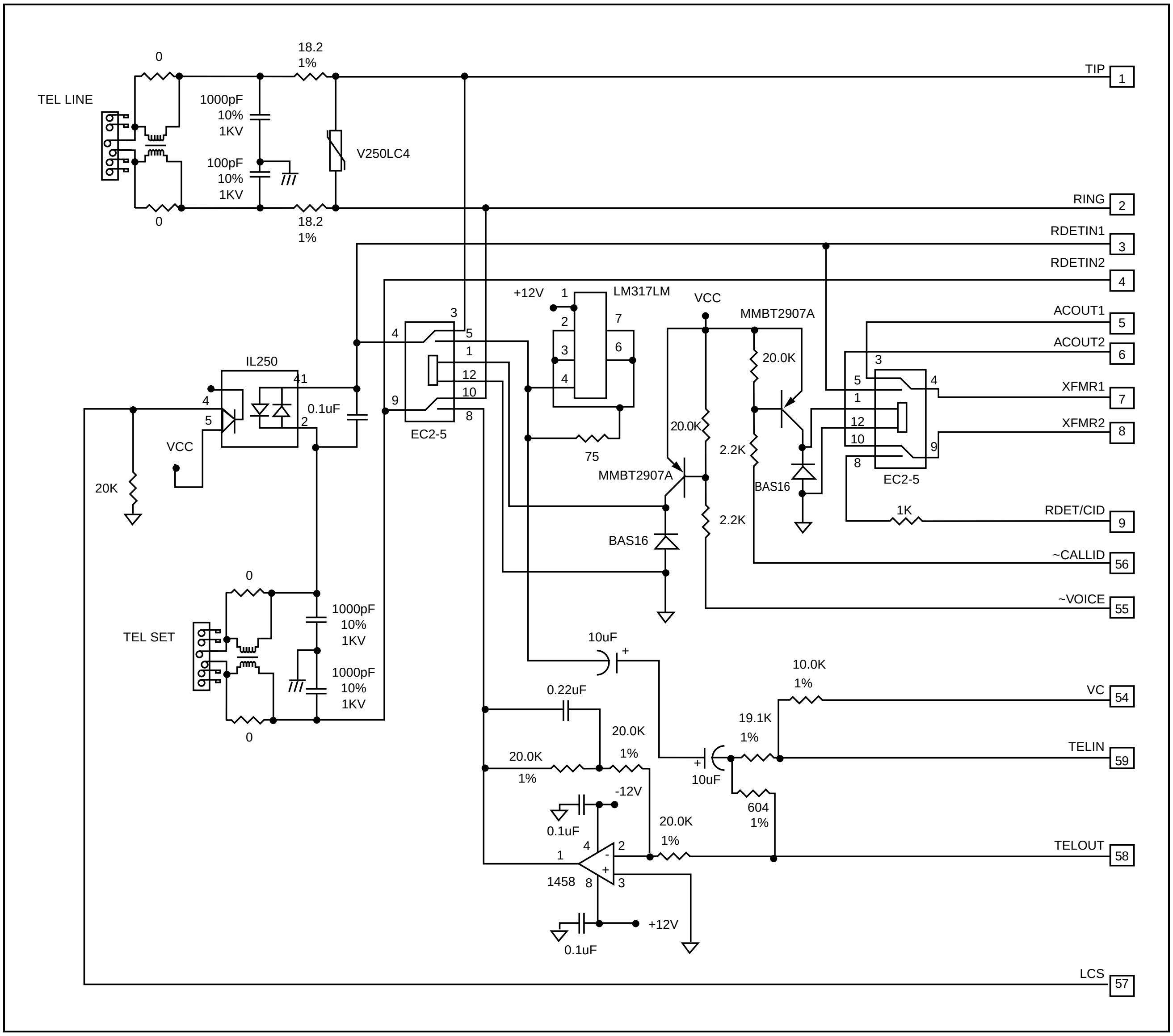

Figure 2-16. SFV336ACF/SP Telephone Line/Telephone/Audio Interface Circuit: External DAA

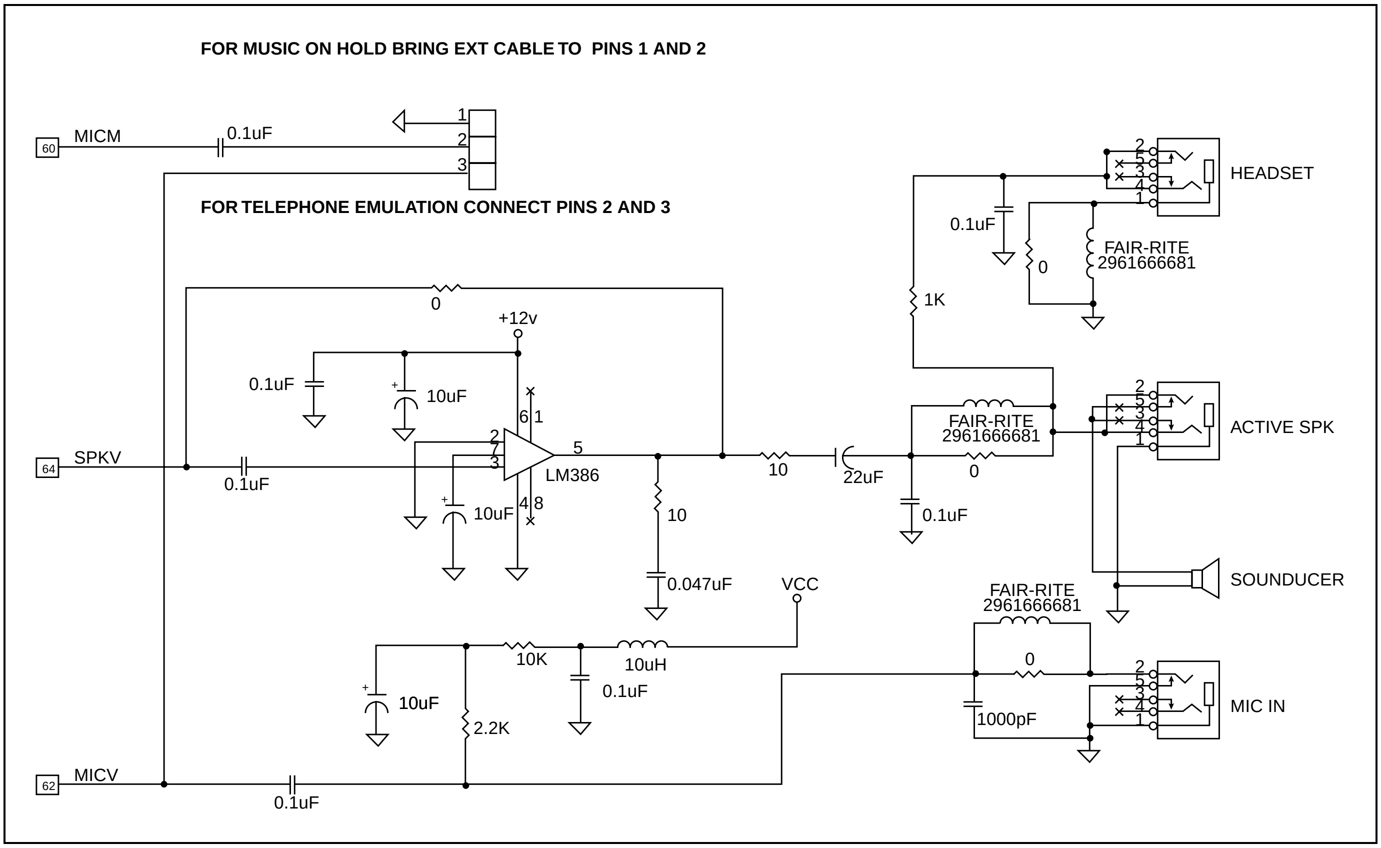

Figure 2-17. SFV336ACF/SP Microphone/Speaker Interface Circuit: External DAA

3. DESIGN CONSIDERATIONS

Good engineering practices must be adhered to when designing a printed circuit board (PCB) containing the SocketModem module. Suppression of noise is essential to the proper operation and performance of the modem itself and for surrounding equipment.

Two aspects of noise in an OEM board design containing the SocketModem module must be considered: on-board/off-board generated noise that can affect analog signal levels and analog-to-digital conversion (ADC)/digital-to-analog conversion (DAC), and on-board generated noise that can radiate off-board. Both on-board and off-board generated noise that is coupled on-board can affect interfacing signal levels and quality, especially in low level analog signals. Of particular concern is noise in frequency ranges affecting modem performance.

On-board generated electromagnetic interference (EMI) noise that can be radiated or conducted off-board is a separate, but equally important, concern. This noise can affect the operation of surrounding equipment. Most local governing agencies have stringent certification requirements that must be met for use in specific environments.

Proper PC board layout (component placement, signal routing, trace thickness and geometry, etc.), component selection (composition, value, and tolerance), interface connections, and shielding are required for the board design to achieve desired modem performance and to attain EMI certification.

All the aspects of proper engineering practices are beyond the scope of this designer's guide. The designer should consult noise suppression techniques described in technical publications and journals, electronics and electrical engineering text books, and component supplier application notes. Seminars addressing noise suppression techniques are often offered by technical and professional associations as well as component suppliers.

3.1 PC BOARD LAYOUT GUIDELINES

3.1.1 General

1. In a 2-layer design, provide an adequate ground grid in all unused space around and under components (judiciously near analog components) on both sides of the board, and connect in such a manner as to avoid small islands. A grid is preferred over a plane to improve solderability. Typically, the grid is composed of .012 in. traces and .012 in. spaces on a .025 in. grid. Connect each grid to other grids on the same side at several points and to grids on the opposite side through the board at several points. Connect SocketModem DGND and AGND pins to the ground grid.
2. In a 4-layer design, provide an adequate ground plane covering the entire board. SocketModem DGND and AGND pins are tied together on the SocketModem.
3. As a general rule, route digital signals on the component side of the PCB and the analog signals on the solder side. The sides may be reversed to match particular OEM requirements. Route the digital traces perpendicular to the analog traces to minimize signal cross coupling.
4. Route the modem signals to provide maximum isolation between noise sources and noise sensitive inputs. When layout requirements necessitate routing these signals together, they should be separated by neutral signals.
5. All power and ground traces should be at least 0.05 in. wide.
6. TIP and RING signal traces are to be no closer than 0.062" from any other traces (Note: absence of pin 3 of the SocketModem supports this requirement.)

3.1.2 Electromagnetic Interference (EMI) Considerations

The following guidelines are offered to specifically help minimize EMI generation. Some of these guidelines are redundant with, or similar to, the general guidelines but are mentioned again to reinforce their importance.

In order to minimize the contribution of the SocketModem-based design to EMI, the designer must understand the major sources of EMI and how to reduce them to acceptable levels.

1. Keep traces carrying high frequency signals as short as possible.
2. Provide a good ground plane or grid. In some cases, a multilayer board may be required with full layers for ground and power distribution.
3. Decouple power from ground with decoupling capacitors as close to the SocketModem module power pins as possible.
4. Eliminate ground loops, which are unexpected current return paths to the power source.

5. Decouple the telephone line cables at the telephone line jacks. Typically, use a combination of series inductors, common mode chokes, and shunt capacitors. Methods to decouple telephone lines are similar to decoupling power lines, however, telephone line decoupling may be more difficult and deserves additional attention. A commonly used design aid is to place footprints for these components and populate as necessary during performance/EMI testing and certification.
6. Decouple the power cord at the power cord interface with decoupling capacitors. Methods to decouple power lines are similar to decoupling telephone lines.
7. Locate high frequency circuits in a separate area to minimize capacitive coupling to other circuits.
8. Locate cables and connectors so as to avoid coupling from high frequency circuits.
9. Lay out the highest frequency signal traces next to the ground grid.
10. If a multilayer board design is used, make no cuts in the ground or power planes and be sure the ground plane covers all traces.
11. Minimize the number of through-hole connections on traces carrying high frequency signals.
12. Avoid right angle turns on high frequency traces. Forty-five degree corners are good, however, radius turns are better.
13. On 2-layer boards with no ground grid, provide a shadow ground trace on the opposite side of the board to traces carrying high frequency signals. This will be effective as a high frequency ground return if it is three times the width of the signal traces.
14. Distribute high frequency signals continuously on a single trace rather than several traces radiating from one point.

3.2 COUNTRY RECOGNITION CODES FOR WORLD-CLASS OPERATION

The World-Class SocketModem can automatically determine that it is connected to a DAA and a DAA-to-line cable (line cable) for a specific country by recognizing an 8-bit country code generated by the DAA and line cable. This allows the modem to select appropriate call progress parameters to match the country. The scheme also allows the modem firmware to identify a mismatch between the line cable and the DAA board.

The World-Class SocketModem does not need a country code recognition circuit to operate properly. A country code recognition circuit is not needed if modem operation is predefined for use in a particular country. It is useful for automatic recognition of interchangeable DAAs.

3.2.1 Country Recognition Circuit

The country code recognition circuit in the DAA is used to automatically determine the country for which the DAA is configured, and can be implemented by a 74HC165 8-bit parallel-to-serial converted (Figure 3-1).

The parallel inputs are connected to ground or to VCC by the cable and DAA board in order to input a code corresponding to the supported country. The MCU outputs a shift register load (~PULSE) signal to load the code into the shift register and a Country Identifier Clock (IDCLK) output to shift the loaded code out of the converter. The converter output is read by the SocketModem on the Country Identifier Code (IDID) input. When used to shift the code out of the converter, the active ~PULSE output is toggled rapidly so the Pulse Relay (which requires a few milliseconds to activate) is not affected.

3.2.2 Country Recognition Codes

The 8-bit country code is composed of 3 bits to identify the printed circuit board (PCB) configuration and 5 bits to identify the line cable configuration.

3.2.3 Country Code Generation

Country codes can be constructed several ways, e.g.:

1. When the line cable is a standard RJ-11 (2-wire) cable, the code can be generated on the DAA board with straps or jumpers.
2. When a portion of the DAA resides on the line cable or when the line cable itself must be coded, then part of the 8-bit code can be generated by straps on the DAA board and the rest of the code generated by jumpers on the line cable connector.
3. Since the same DAA board and cable can be used, bit 4 of the country code can be strapped on the DAA board to select the appropriate country.

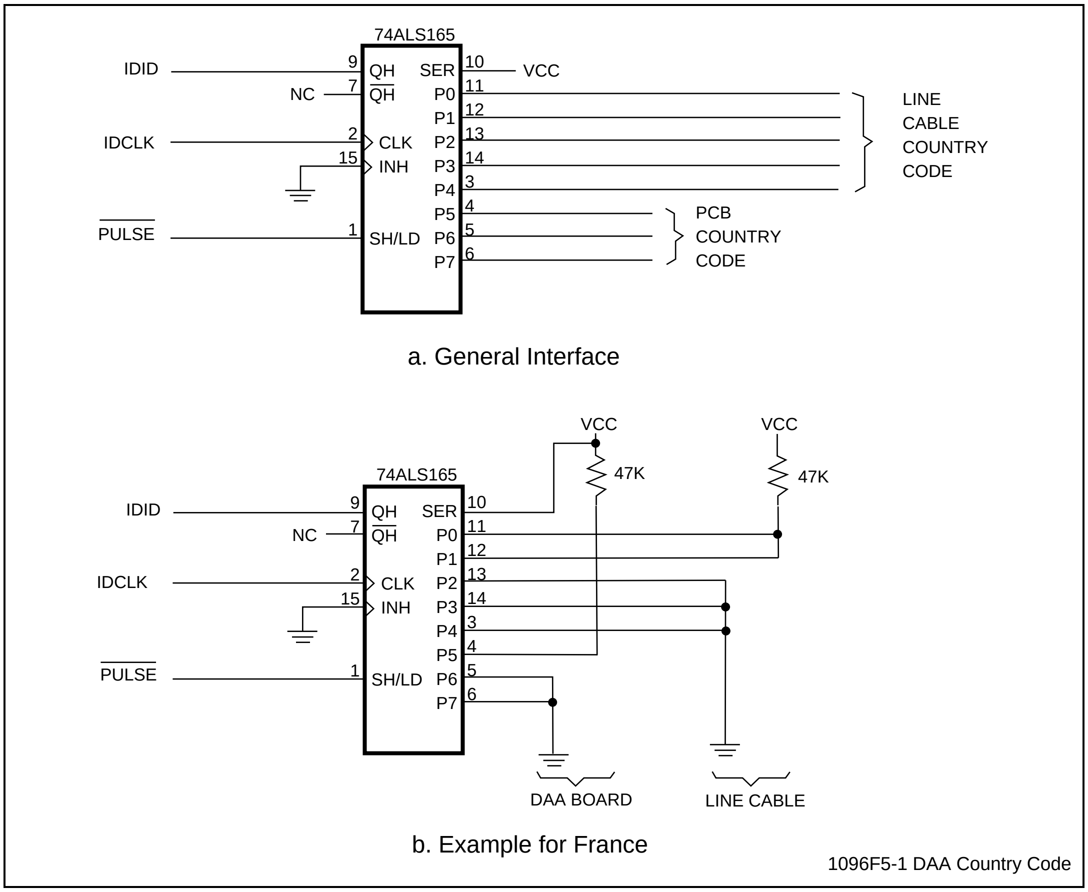

Figure 3-1. Country Code Circuit

3.3 PRODUCT MIGRATION GUIDELINES

The SocketModem products are pin-compatible across families. A host board designed initially for the SM224ATF, for example, can readily support a SM96V24ACW/U, a SMV144ACW/U, or a SMV288ACW provided a few guidelines are followed:

- Design in External Memory interface, including Address, Data, and Control lines, and add pads for the ROM or ROM socket.
- If using an external DAA, be sure it can handle highest anticipated connect rates.

Note that the SFV336ACFW/SP uses non-standard pinouts. Only the SFV336ACF-HxD5A0P1 from the SFV366ACFW/SP family will function properly in existing SMV144AC/U-HxD4A0P0 or SM224ATF-HxD4A0P1 designs.

3.4 OTHER CONSIDERATIONS

The pins of all SocketModems are grouped according to function. The DAA interface, Host interface, LED interface, and Memory interface pins are all conveniently arranged, easing the host board layout design. EIA-232 serial signals, for example, could be easily routed to a DB-9 connector, or to a smaller form-factor cable connector that leads off to a cable with a DB-9 or a DB-25 connector on the other end.

SocketModems that do not have a pin 3 provide a socket-mating key. SocketModem sockets, or holes drilled in host boards, should have pin 3 blocked to prevent incorrect orientation during insertion.

The DAA designs described in this designer's guide are wet DAAs, i.e., they require line current to be present to pass the signal. Therefore, if the modem is to be connected back-to-back by cable directly to another modem, the modems will not be able to connect. The DAAs must be modified to operate dry, i.e., without line current, when used in this environment.

4. PACKAGE DIMENSIONS

Package dimensions are shown in Figure 4-1 (SM224ATF), Figure 4-2 (SM96V24ACW/U), Figure 4-3, (SMV144ACW/U and SMV288ACW), Figure 4-4 (SSV144ACW/U and SSV288ACW) and Figure 4-5 (SFV336ACFW/SP).

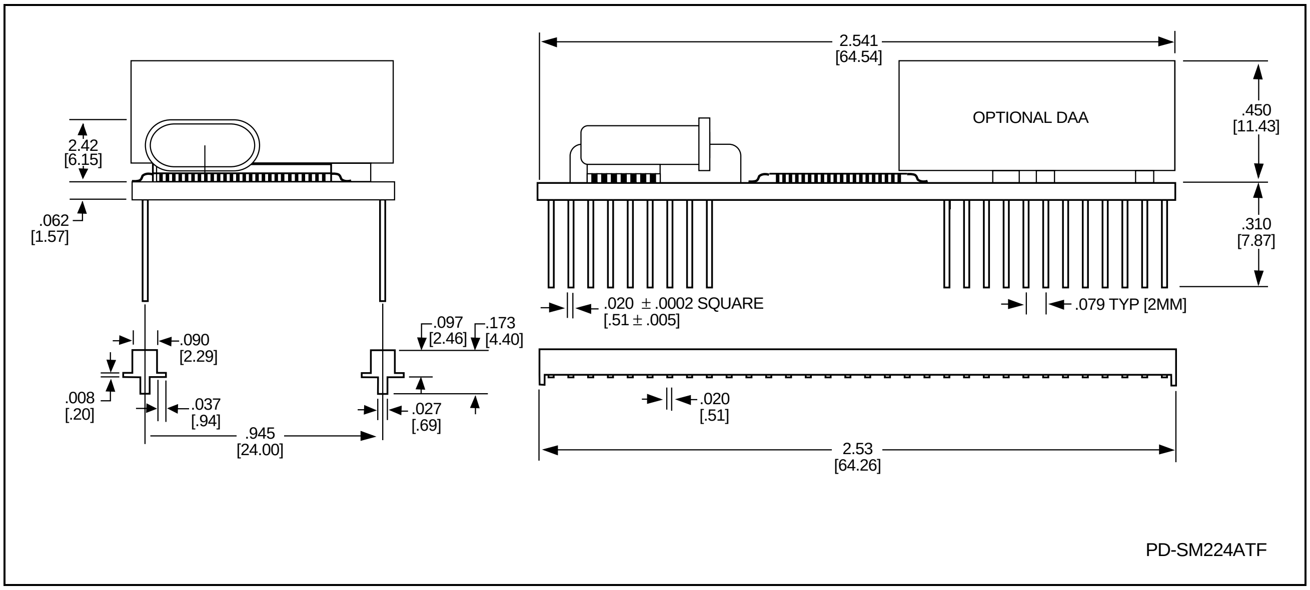

Figure 4-1. SocketModem Physical Dimensions - SM224ATF

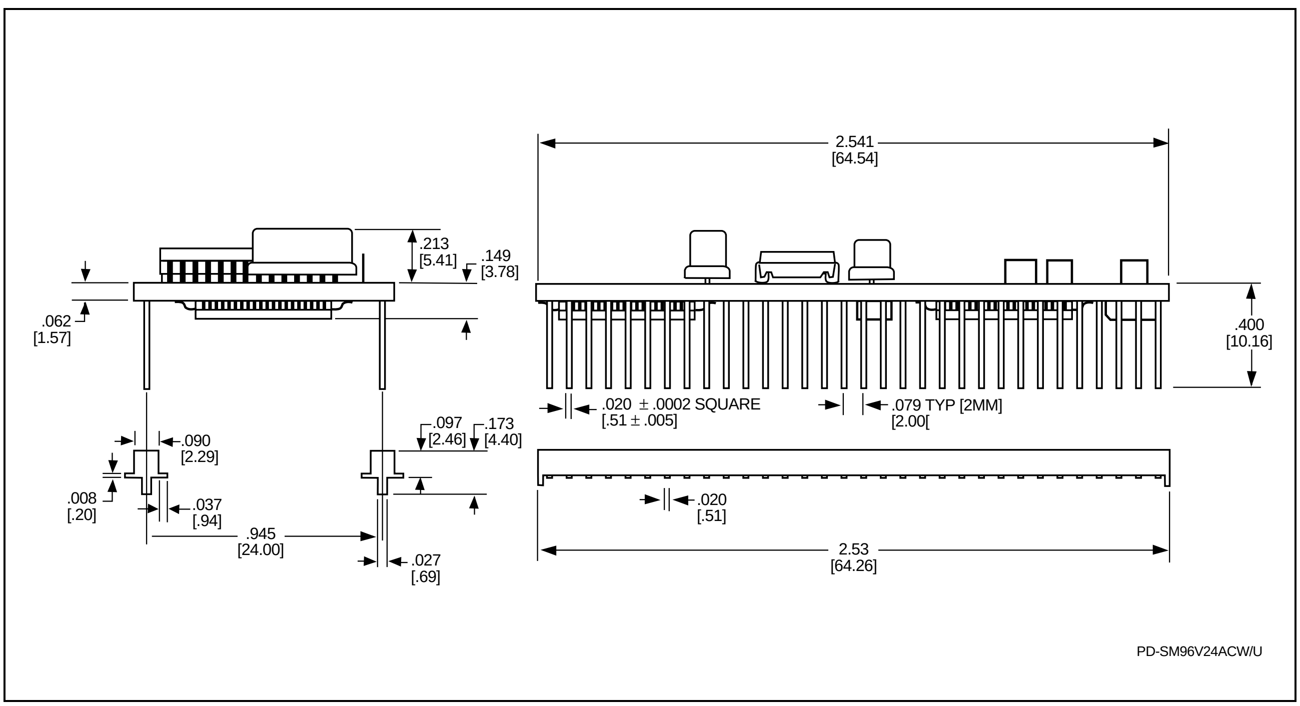

Figure 4-2. SocketModem Physical Dimensions - SM96V24ACW/U

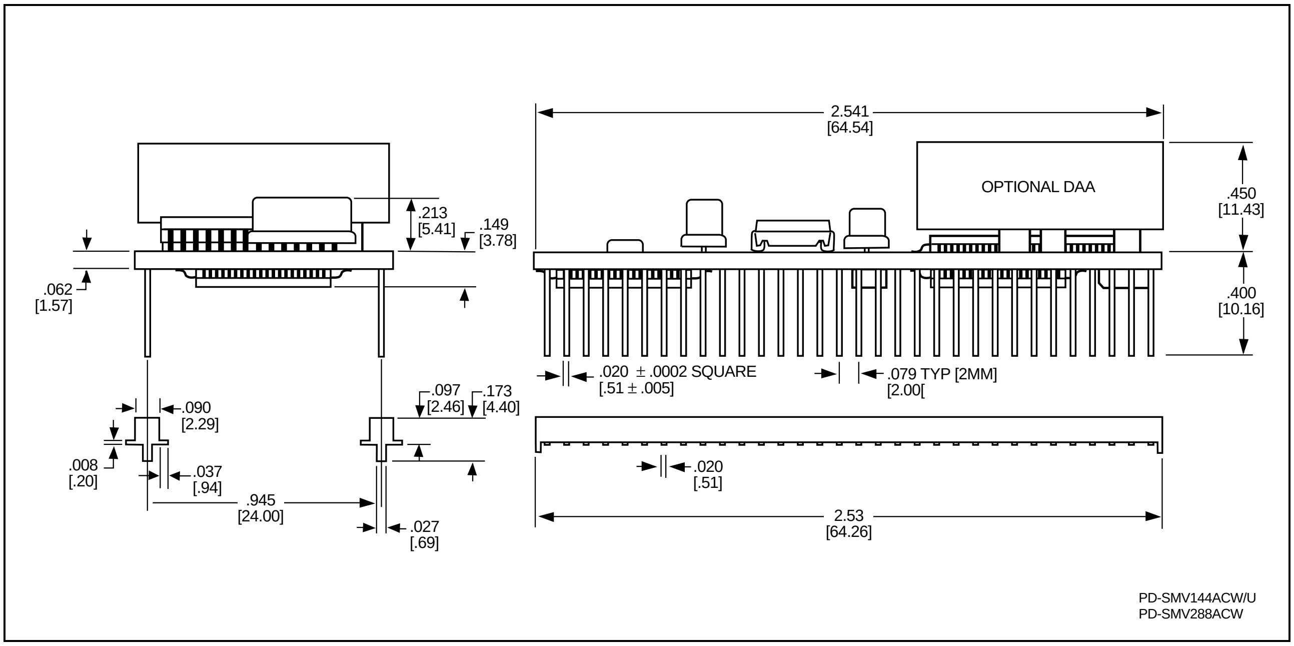

Figure 4-3. SocketModem Physical Dimensions - SMV144ACW/U

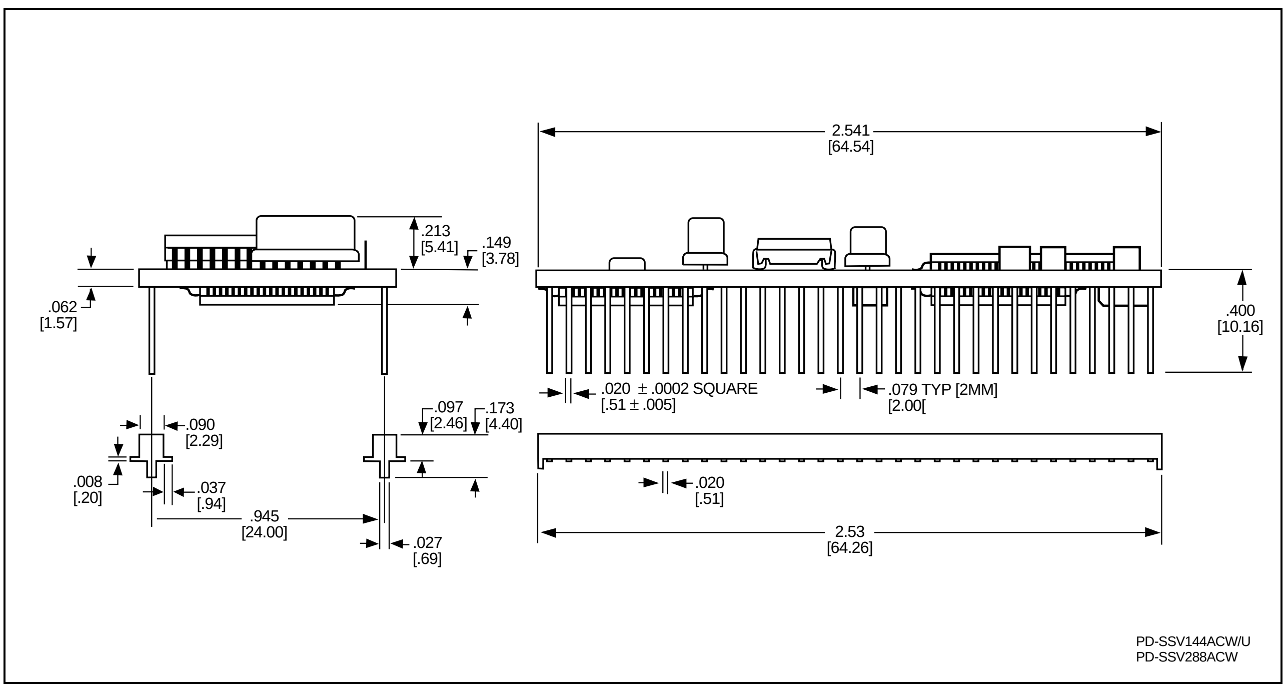

Figure 4-4. SocketModem Physical Dimensions - SSV144ACW/U, SMV288ACW, and SSV288ACW

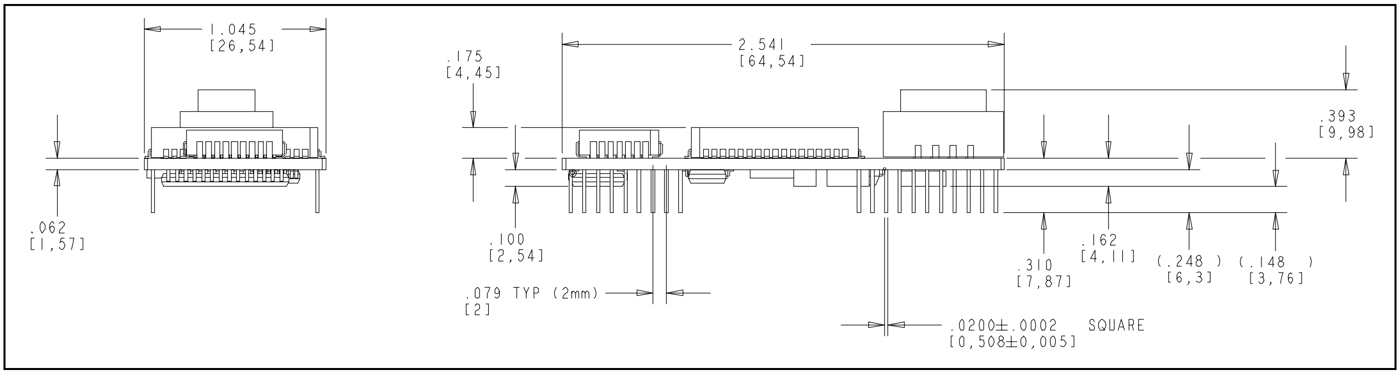

Figure 4-5. SocketModem Physical Dimensions - SFV336ACFW/SP

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5. SOCKETMODEM DESIGN WITH SERIAL INTERFACE

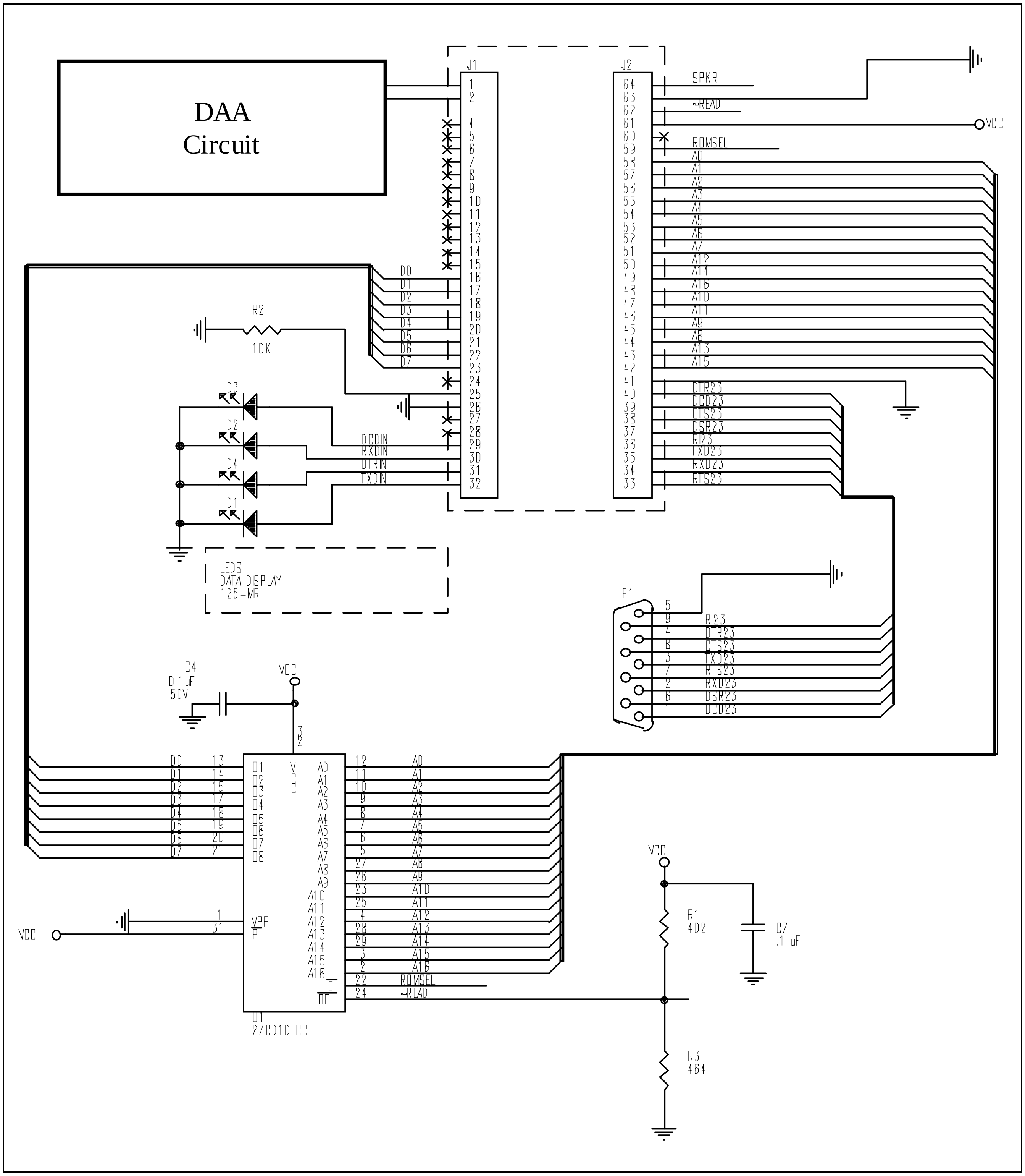

Figure 5-1. Serial Interface Example

Table 5-1. Serial Interface Example Bill of Materials

Quantity	Reference	Part
1	C2	Capacitor, 0.10uF, 25V, 20%, Ceramic
1	C4	Capacitor, 1000pF, 50V, 20%, Ceramic
4	D1, D2, D3, D4	LED
2	J1, J2	Socket, 32-pin, 2mm SIP (SamTec SMM-132-01-F-S)
1	J3	Connector, DB-9
1	R1	Resistor, 402Ω
1	R2	Resistor, 10KΩ
1	R3	Resistor, 464Ω
1	U1	Socket, 32-pin EPROM

6. SOCKETMODEM DESIGN WITH PARALLEL INTERFACE

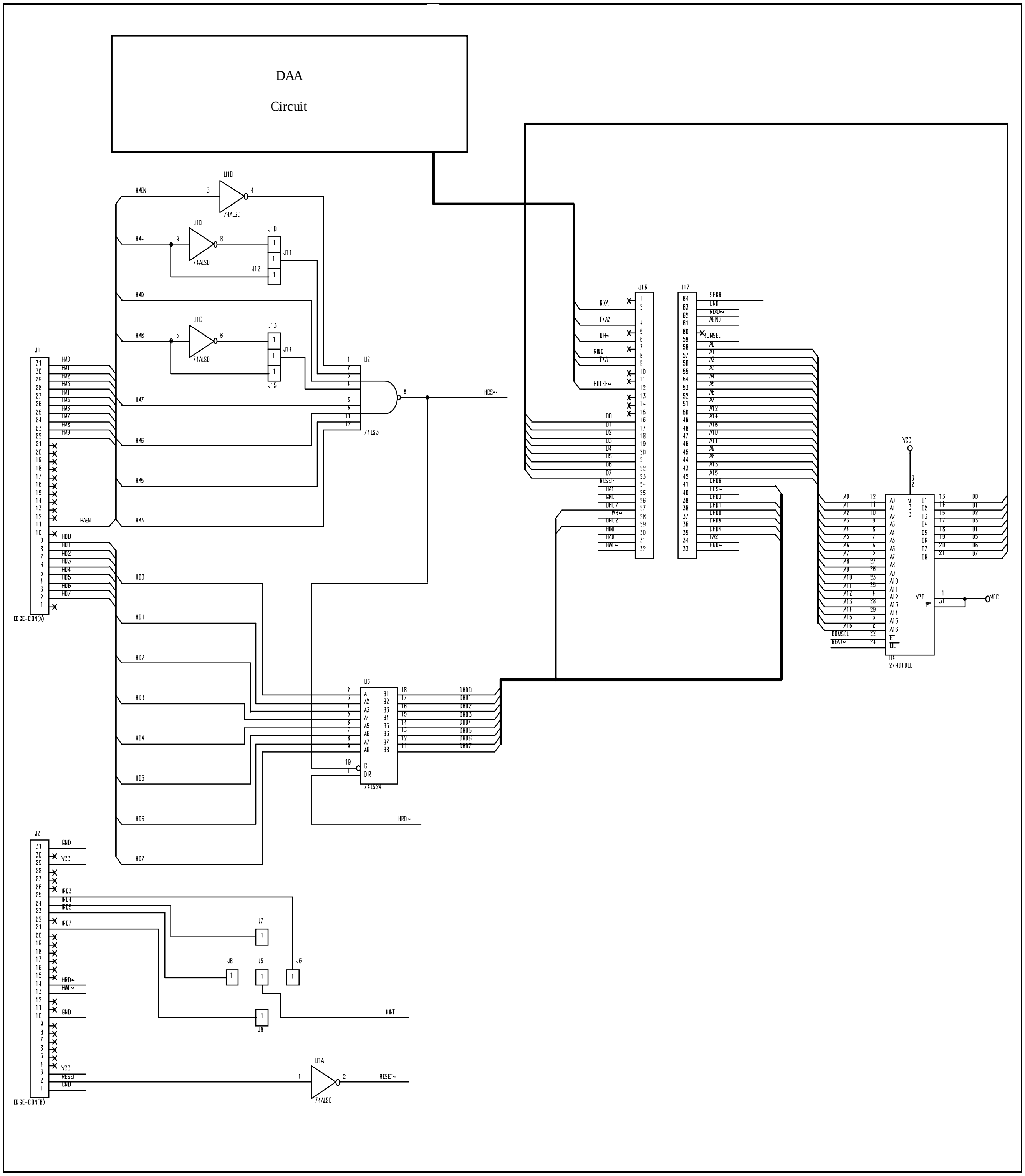

Figure 6-1. General-Purpose Parallel Interface

Table 6-1. Parallel Interface Example Bill of Materials

Quantity	Reference	Part
2	J16, J17	Socket, Single Row, 2mm, 32-pin (SamTec SMM-132-01-F-S)
1	U1	74ALS04, Hex Inverter
1	U2	74LS30, 8-Input Positive NAND Gate
1	U3	74LS245, Octal Bus Transceiver
1	U4	Socket, EPROM, 32-pin

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