

SocketModem™ SF Series

Designer's Guide (Preliminary)

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Table of Contents

1. INTRODUCTION	1-1
1.1 SUMMARY	1-1
1.1.1 High Speed	1-1
1.1.2 Low Speed	1-1
1.2 TECHNICAL OVERVIEW	1-2
1.2.1 SUPPORTED INTERFACES	1-2
Parallel Interface	1-3
Serial/Indicator Interface	1-3
Speaker Interface	1-3
Line Interface	1-3
European Line Interface	1-3
1.3 COMMAND SETS AND S REGISTERS	1-3
2. HARDWARE INTERFACE	2-1
2.1 SFV144ACF, SFV336ACF AND SFV56ACL INTERFACE SIGNALS	2-1
2.2 SF224ATF INTERFACE SIGNALS	2-1
2.3 SIGNAL DESCRIPTIONS	2-1
2.4 FIRMWARE ROM	2-15
2.5 DAA INTERFACE	2-15
2.5.1 ~PULSE Filter Circuit	2-19
2.5.2 Audio Interface	2-20
2.5.3 SFV336ACFW Telephone Line/Telephone/Audio Interface	2-21
3. DESIGN CONSIDERATIONS	3-1
3.1 PC BOARD LAYOUT GUIDELINES	3-1
3.1.1 General	3-1
3.1.2 Electromagnetic Interference (EMI) Considerations	3-1
3.2 PRODUCT MIGRATION GUIDELINES	3-3
3.3 OTHER CONSIDERATIONS	3-3
3.4 MANUFACTURING CONSIDERATIONS	3-3
4. PACKAGE DIMENSIONS	4-1
5. SOCKETMODEM DESIGN WITH SERIAL INTERFACE	5-1
6. SOCKETMODEM DESIGN WITH PARALLEL INTERFACE	6-1
7. EUROPEAN SOCKETMODEM INSTALLATION GUIDELINES	7-1
7.1 CONSIDERATIONS FOR TELECOM APPROVALS	7-1
7.1.1 PSTN Connection	7-1
7.2 CONSIDERATIONS FOR ELECTRICAL SAFETY	7-2
7.2.1 Conditions for Maintaining Safety Compliance	7-2
7.2.2 Power Supply	7-2
7.2.3 Clearances, Creepage Distances and Distances through Insulation	7-2
7.3 CONSIDERATIONS FOR EMC	7-3
7.3.1 EMC Compliance	7-3
7.3.2 Installation in Host Systems	7-3

List of Figures

Figure 1-1. Typical Serial and Parallel Block Diagrams	1-2
Figure 2-1. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial TTL Pinout (~ indicates active low)	2-2
Figure 2-2. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial EIA-232 Pinout (~ indicates active low)	2-3
Figure 2-3. SFV144ACF, SFV336ACF and SFV56ACL Host Parallel Pinout (~ indicates active low)	2-4
Figure 2-4. SFV144ACF, SFV336ACF and SFV56ACL DAA and Audio Pinouts	2-5
Figure 2-5. SF224ATF Serial TTL Pinout (~ indicates active low)	2-6
Figure 2-6. SF224ATF Serial EIA-232 Pinout (~ indicates active low)	2-7
Figure 2-7. SF224ATF Host Parallel Pinout (~ indicates active low)	2-8
Figure 2-8. Example of DAA Interface for SocketModems with Self-Contained U.S. DAAs (D5 and D6 Options)	2-15
Figure 2-9. Example of DAA Interface for SocketModems with Self-Contained U.S. DAAs (D5 and D6 Options)	2-16
Figure 2-10. Recommended Telco Interface for European SocketModems (DF, DG, DT, DE and DB Options)	2-16
Figure 2-11. External DAA Example	2-17
Figure 2-12. ~PULSE Filter Circuit	2-19
Figure 2-13. Sounducer Driver Circuit	2-20
Figure 2-14. Speaker Driver Circuit	2-20
Figure 2-15. Audio Circuitry for Audio and Speaker Phone operation	2-21
Figure 2-16. SFV336ACF Telephone Line/Telephone/Audio Interface Circuit	2-23
Figure 2-17. SFV336ACF Telephone Line/Telephone Handset/Audio Interface Circuit: D6 Option	2-24
Figure 4-1. SocketModem Physical Dimensions - SF224ATF	4-1
Figure 4-2. SocketModem Physical Dimensions - SFV144ACF, SFV336ACF and SFV56ACL (D5 and D6 Options)	4-1
Figure 4-3. European Socket Modem Physical Dimensions - SFV144ACF, SFV336ACF (DF, DG, DT, DE and DB Options)	4-2
Figure 5-1. Serial Interface Example	5-1
Figure 6-1. General-Purpose Parallel Interface	6-1

List of Tables

Table 2-1. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial TTL Signals.....	2-2
Table 2-2. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial EIA-232 Signals	2-3
Table 2-3. SFV144ACF, SFV336ACF and SFV56ACL Host Parallel Signals	2-4
Table 2-4. SF224ATF Serial TTL Signals	2-6
Table 2-5. SF224ATF Serial EIA-232 Signals	2-7
Table 2-6. SF224ATF Host Parallel Signals.....	2-8
Table 2-7. Signal Descriptions	2-9
Table 2-8. Digital Electrical Characteristics.....	2-13
Table 2-9. Analog Electrical Characteristics	2-14
Table 2-10. External DAA Bill of Materials.....	2-18
Table 6-1. Parallel Interface Example Bill of Materials	6-2

SocketModem SF Series Designer's Guide

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1. INTRODUCTION

1.1 SUMMARY

The Rockwell SF Series SocketModem™ family of pin-compatible data/fax/voice/audio modem engines provides the OEM with a complete K56 Flex, 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 56,000 bps data download/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. The pin compatibility between the full range of SF Series 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 up to 56,000 bps download and up to 33,600 bps upload (SFV56ACFW), 33,600 bps (SFV336ACF) or 14,400 bps (SFV144ACF). Error correction (V.42/MNP 2-4) and data compression (V.42bis/MNP 5) maximize data transfer integrity and boost average throughput up to 230.4 kbps (SFV56ACFW), 115.2 kbps (SFV336ACF) or 57.6 kbps (SFV144ACF). The High Speed SocketModem also operates in non-error-correcting mode. AutoSync operation is supported in SFV336ACF and SFV144ACF.

As a fax modem, the High Speed SocketModem supports Group 3 send and receive rates up to 14400 bps and supports Class 1 protocols.

The High Speed SF Series SocketModem with Voice features (SFV56ACF, SFV336ACF and SFV144ACF) 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, digital telephone answering machine (DTAM), voice annotation, and audio recording and playback applications.

The SFV56ACF, SFV336ACF, and SFV144ACF support position-independent, full-duplex speakerphone (FDSP) operation using an advanced algorithm that includes both acoustic and line echo cancellation.

The SFV336ACF and SFV144ACF support analog simultaneous audio/voice and data (AudioSpan) operation at data rates (plus audio) 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. The SFV56ACF supports AudioSpan operation at a data rate of 4.8 kbps plus audio in V.61 mode.

PC-based "ConfigurACE™ II for Windows" software allows MCU firmware to be customized to application requirements.

1.1.2 Low Speed

As a data modem, the Low Speed SocketModem operates at line speeds to 2400 bps (SF224ATF).

Fax modes, controlled by built-in Class 1 command interface (SF224ATF) provide Group 3 transmit functions up to 9600 bps and receive functions up to 4800 bps.

Full error correction (V.42 LAPM, MNP2-4) and data compression (V.42bis, MNP 5) capabilities are supported in the SF224ATF through the Rockwell Protocol Interface (RPI) and host communication software supporting the RPI. A list of communication software supporting RPI can be obtained from your local Rockwell sales representative.

SocketModem SF Series Designer's Guide

1.2 TECHNICAL OVERVIEW

1.2.1 SUPPORTED INTERFACES

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

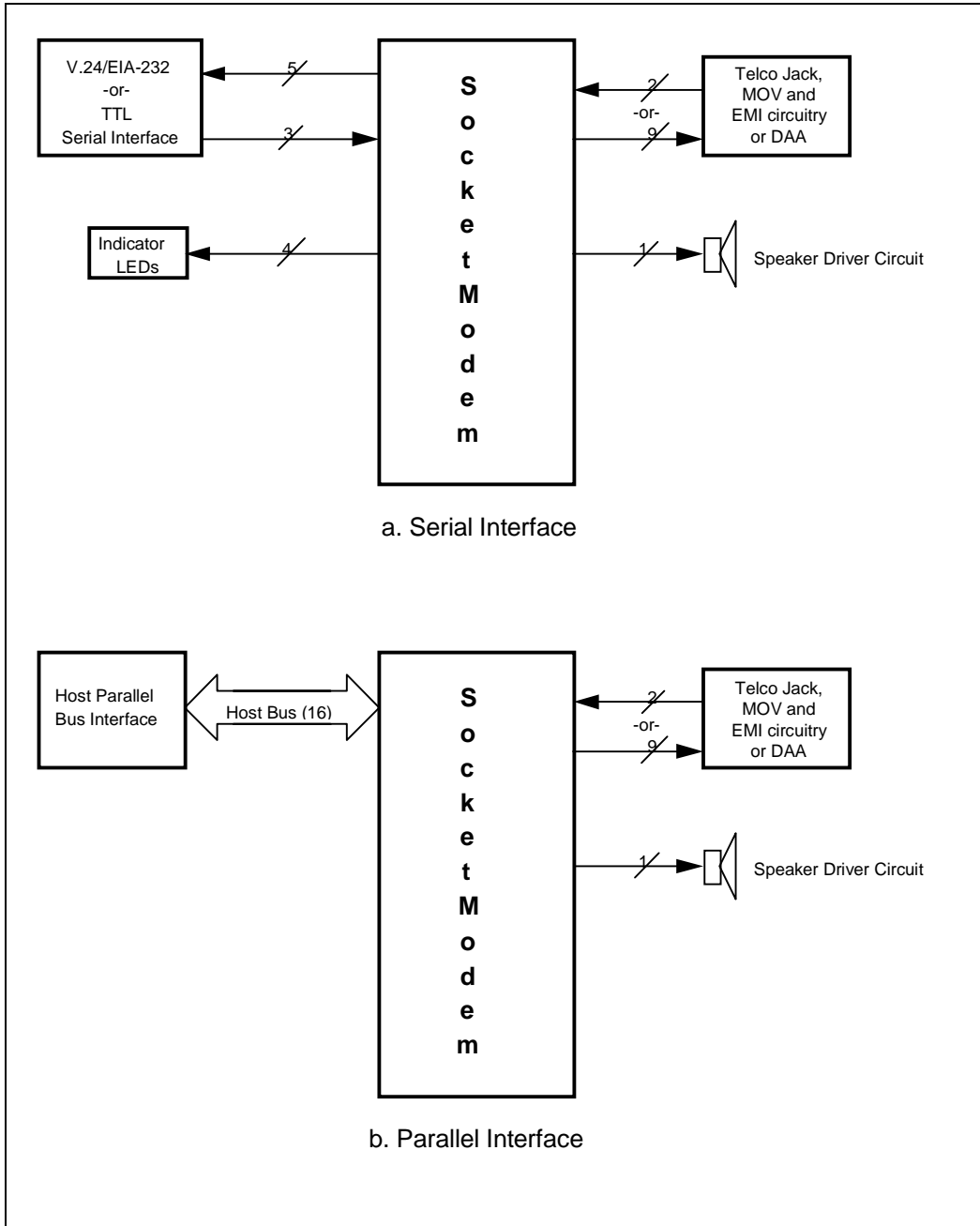


Figure 1-1. Typical Serial and Parallel Block Diagrams

SocketModem SF Series Designer's Guide

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 SF224ATF) 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.

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 (D5, D6, and European options)

European Line Interface

The SFV336ACF and SFV144ACF SocketModem includes configurations for use in five European countries: France, Germany, Italy, Spain, and the United Kingdom. These SocketModems are fully tested for compliance with their respective PTT regulations and are certified for use in these countries.

1.3 COMMAND SETS AND S REGISTERS

Modem operation is controlled by AT and S register commands issued by the DTE. The AT command sets differ among the SocketModem families. Refer to the *AT Commands for the RCV56ACx, RCV336ACFx, RCV288ACx, and RCV144ACx Modems Reference Manual* (Order No. 1048), *RCVDL56ACFL/SP Modem Designer's Guide* (Order No. 1121), *RCV336ACF/SP Modem Designer's Guide* (Order No. 1046), *RCV144ACFx Modem Designer's Guide* (Order No. 1046), and the *RC224AT 2400 bps Single Device Modem with 'AT' Commands Designer's Guide* (Order No. 845) for details.

SocketModem SF Series Designer's Guide

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2. HARDWARE INTERFACE

2.1 SFV144ACF, SFV336ACF AND SFV56ACL INTERFACE SIGNALS

The SFV56ACFW, SFV336ACFW and SFV144ACFW SocketModem pin assignments with DTE serial TTL interface are shown in Figure 2-1 and are listed in Table 2-1.

The SFV56ACFW, SFV336ACFW and SFV144ACFW SocketModem pin assignments with DTE serial EIA-232 interface are shown in Figure 2-2 and are listed in Table 2-2.

The SFV56ACFW, SFV336ACFW and SFV144ACFW SocketModem pin assignments with host parallel interface are shown in Figure 2-3 and are listed in Table 2-3.

The SFV56ACFW, SFV336ACFW and SFV144ACFW SocketModem DAA and Audio pinouts are shown in Figure 2-5.

2.2 SF224ATF INTERFACE SIGNALS

The SF224ATF SocketModem pin assignments with DTE serial TTL interface are shown in Figure 2-5 and are listed in Table 2-4.

The SF224ATF SocketModem pin assignments with DTE serial EIA-232 interface are shown in Figure 2-6 and are listed in Table 2-5.

The SF224ATF SocketModem pin assignments with host parallel interface are shown in Figure 2-7 and are listed in Table 2-6.

2.3 SIGNAL DESCRIPTIONS

The SocketModem interface signals are described in Table 2-7.

The digital electrical characteristics are listed in Table 2-8.

The analog electrical characteristics are listed in Table 2-9.

SocketModem SF Series Designer's Guide

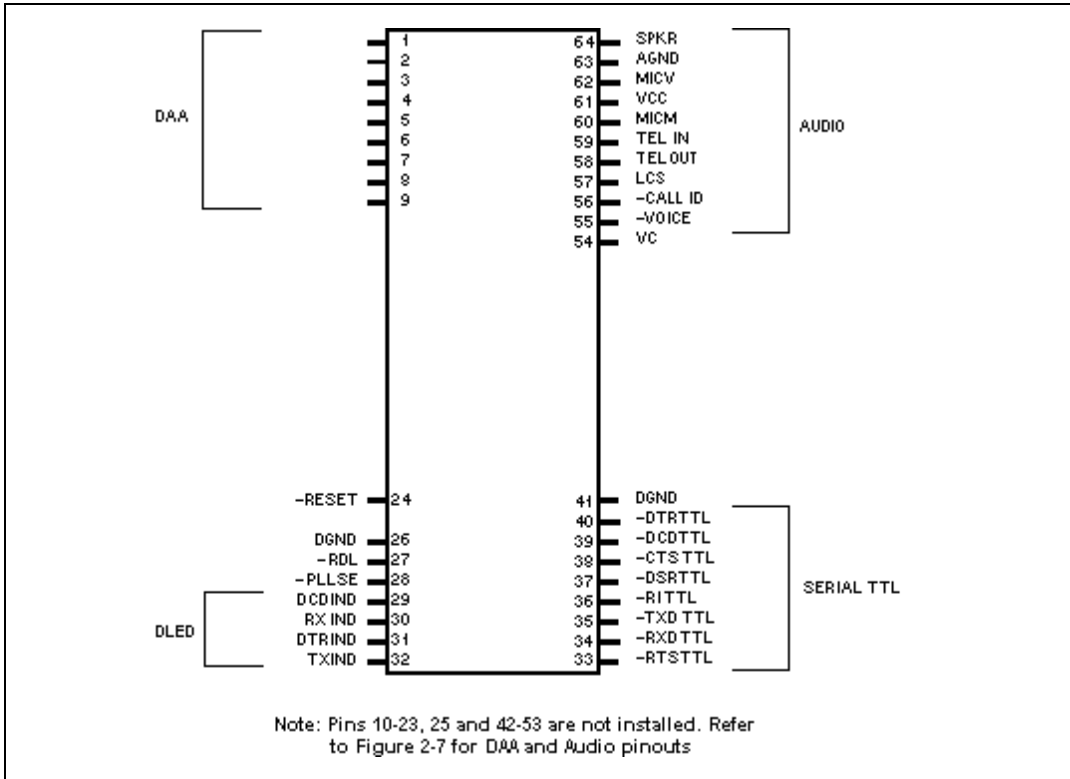


Figure 2-1. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial TTL Pinout
(~ indicates active low)

Table 2-1. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial TTL Signals

Pin	D0	D5	D6	I/O Type	Pin	D0	D5	D6	I/O Type
1	NC	TIP	TIP	NC, I/O, I/O	33	~RTSTTL	~RTSTTL	~RTSTTL	Input
2	~OH	RING	RING	Output, I/O, I/O	34	~RXDTTL	~RXDTTL	~RXDTTL	Output
3	NC	no pin	RDETIN1	NC, NC, Input	35	~TXDTTL	~TXDTTL	~TXDTTL	Input
4	RINGD	no pin	RDETIN2	Input, NC, Input	36	~RITTL	~RITTL	~RITTL	Output
5	no pin	no pin	ACOUT1	NC, NC, I/O	37	~DSRTTL	~DSRTTL	~DSRTTL	Output
6	NC	no pin	ACOUT2	INC, NC, /O	38	~CTSTTL	~CTSTTL	~CTSTTL	Output
7	TXA1	no pin	XFMR1	Output, NC, I/O	39	~DCDTTL	~DCDTTL	~DCDTTL	Output
8	TXA2	no pin	XFMR2	Output, NC, I/O	40	~DTRTTL	~DTRTTL	~DTRTTL	Input
9	RXA	no pin	RDET/CID	Input, NC, Input	41	DGND	DGND	DGND	GND
10	no pin	no pin	no pin		42	no pin	no pin	no pin	
11	no pin	no pin	no pin		43	no pin	no pin	no pin	
12	no pin	no pin	no pin		44	no pin	no pin	no pin	
13	no pin	no pin	no pin		45	no pin	no pin	no pin	
14	no pin	no pin	no pin		46	no pin	no pin	no pin	
15	no pin	no pin	no pin		47	no pin	no pin	no pin	
16	no pin	no pin	no pin		48	no pin	no pin	no pin	
17	no pin	no pin	no pin		49	no pin	no pin	no pin	
18	no pin	no pin	no pin		50	no pin	no pin	no pin	
19	no pin	no pin	no pin		51	no pin	no pin	no pin	
20	no pin	no pin	no pin		52	no pin	no pin	no pin	
21	no pin	no pin	no pin		53	no pin	no pin	no pin	
22	no pin	no pin	no pin		54	VC	no pin	VC	Output, NC, Output
23	no pin	no pin	no pin		55	~VOICE	no pin	~VOICE	Output, NC, Output
24	~RESET	~RESET	~RESET	Input	56	~CALLID	no pin	~CALLID	Output, NC, Output
25	no pin	no pin	no pin		57	LCS	no pin	LCS	Input, NC, Input
26	DGND	DGND	DGND	GND	58	TELOUT	no pin	TELOUT	Output, NC, Output
27	~RDL	~RDL	~RDL	Input	59	TELIN	no pin	TELIN	Input, NC, Input
28	~PULSE	~PULSE	~PULSE	Output	60	MICM	no pin	MICM	Input, NC, Input
29	DCDIND	DCDIND	DCDIND	Output	61	VCC	VCC	VCC	POWER
30	RXIND	RXIND	RXIND	Output	62	MICV	NC	MICV	Input, NC, Input
31	DTRIND	DTRIND	DTRIND	Output	63	AGND	AGND	AGND	GND
32	TXIND	TXIND	TXIND	Output	64	SPKR	SPKR	SPKR	Output

SocketModem SF Series Designer's Guide

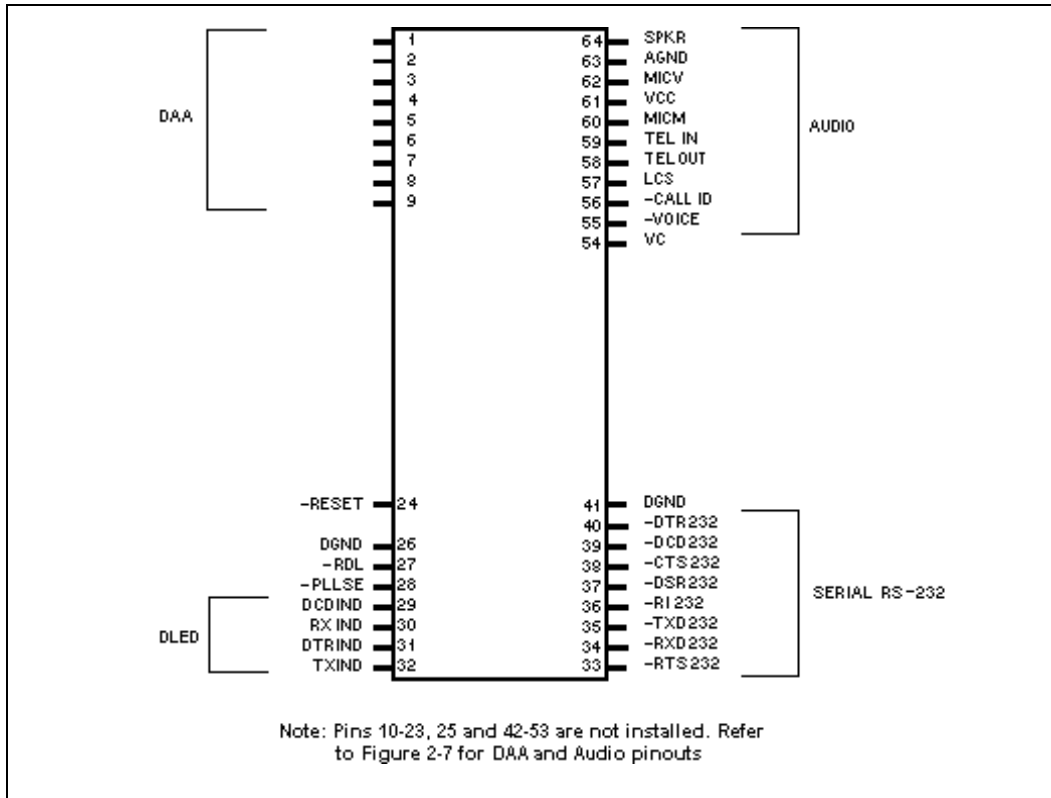


Figure 2-2. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial EIA-232 Pinout
(~ indicates active low)

Table 2-2. SFV144ACF, SFV336ACF and SFV56ACL DTE Serial EIA-232 Signals

Pin	D0	D5	D6	I/O Type	Pin	D0	D5	D6	I/O Type
1	NC	TIP	TIP	NC, I/O, I/O	33	RTS232	RTS232	RTS232	Input
2	~OH	RING	RING	Output, I/O, I/O	34	RXD232	RXD232	RXD232	Output
3	NC	no pin	RDETIN1	NC, NC, Input	35	TXD232	TXD232	TXD232	Input
4	RINGD	no pin	RDETIN2	Input, NC, Input	36	RI232	RI232	RI232	Output
5	no pin	no pin	ACOUT1	NC, NC, I/O	37	DSR232	DSR232	DSR232	Output
6	NC	no pin	ACOUT2	INC, NC, /O	38	CTS232	CTS232	CTS232	Output
7	TXA1	no pin	XFMR1	Output, NC, I/O	39	DCD232	DCD232	DCD232	Output
8	TXA2	no pin	XFMR2	Output, NC, I/O	40	DTR232	DTR232	DTR232	Input
9	RXA	no pin	RDET/CID	Input, NC, Input	41	DGND	DGND	DGND	GND
10	no pin	no pin	no pin		42	no pin	no pin	no pin	
11	no pin	no pin	no pin		43	no pin	no pin	no pin	
12	no pin	no pin	no pin		44	no pin	no pin	no pin	
13	no pin	no pin	no pin		45	no pin	no pin	no pin	
14	no pin	no pin	no pin		46	no pin	no pin	no pin	
15	no pin	no pin	no pin		47	no pin	no pin	no pin	
16	no pin	no pin	no pin		48	no pin	no pin	no pin	
17	no pin	no pin	no pin		49	no pin	no pin	no pin	
18	no pin	no pin	no pin		50	no pin	no pin	no pin	
19	no pin	no pin	no pin		51	no pin	no pin	no pin	
20	no pin	no pin	no pin		52	no pin	no pin	no pin	
21	no pin	no pin	no pin		53	no pin	no pin	no pin	
22	no pin	no pin	no pin		54	VC	no pin	VC	Output, NC, Output
23	no pin	no pin	no pin		55	~VOICE	no pin	~VOICE	Output, NC, Output
24	~RESET	~RESET	~RESET	Output	56	~CALLID	no pin	~CALLID	Output, NC, Output
25	no pin	no pin	no pin		57	LCS	no pin	LCS	Input, NC, Input
26	DGND	DGND	DGND	GND	58	TELOUT	no pin	TELOUT	Output, NC, Output
27	~RDL	~RDL	~RDL	Input	59	TELIN	no pin	TELIN	Input, NC, Input
28	~PULSE	~PULSE	~PULSE	Output	60	MICM	no pin	MICM	Input, NC, Input
29	DCDIND	DCDIND	DCDIND	Output	61	VCC	no pin	VCC	POWER
30	RXIND	RXIND	RXIND	Output	62	MICV	NC	MICV	Input, NC, Input
31	DTRIND	DTRIND	DTRIND	Output	63	AGND	AGND	AGND	GND
32	TXIND	TXIND	TXIND	Output	64	SPKR	SPKR	SPKR	Output

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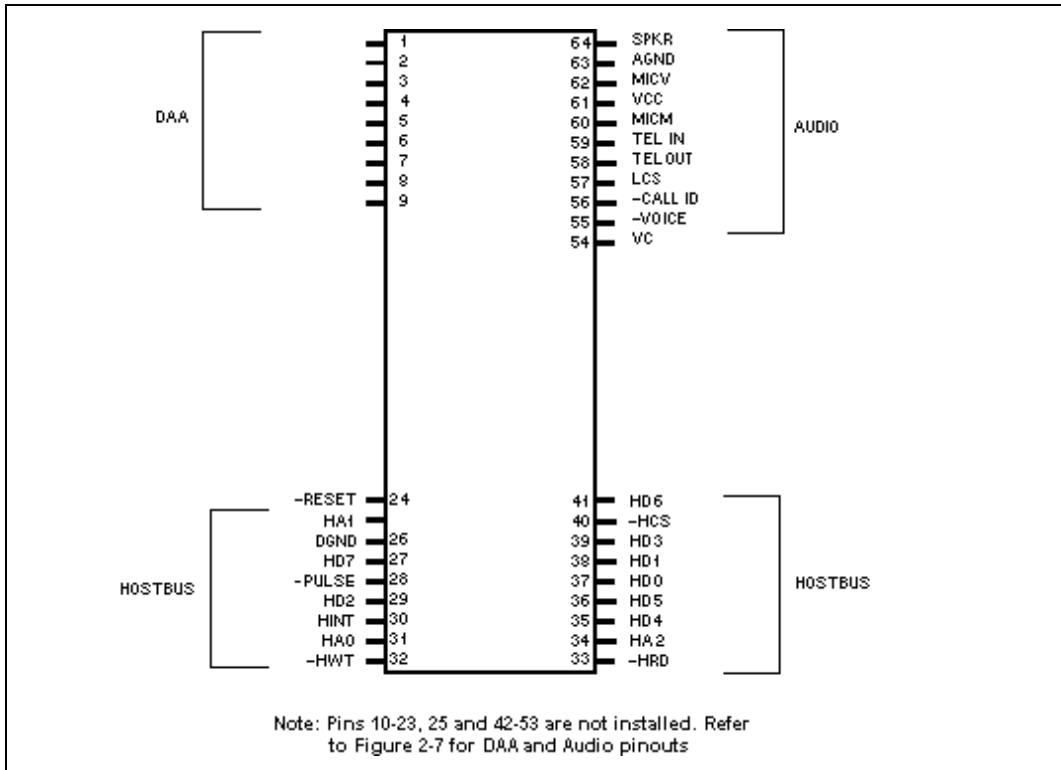
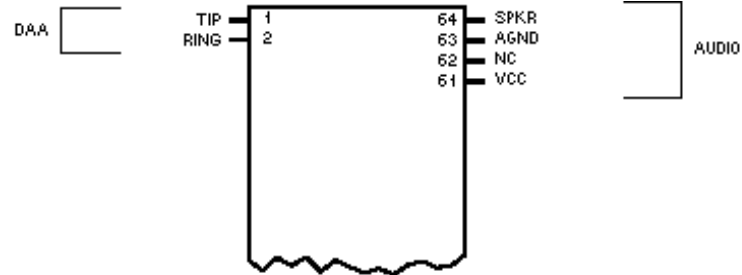


Figure 2-3. SFV144ACF, SFV336ACF and SFV56ACL Host Parallel Pinout
(~ indicates active low)

Table 2-3. SFV144ACF, SFV336ACF and SFV56ACL Host Parallel Signals

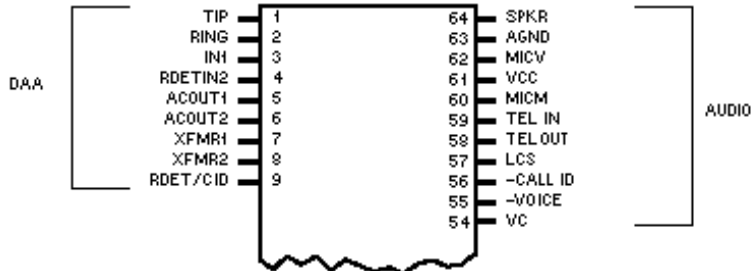
Pin	D0	D5	D6	I/O Type	Pin	D0	D5	D6	I/O Type
1	NC	TIP	TIP	NC, I/O, I/O	33	~HRD	~HRD	~HRD	Input
2	~OH	RING	RING	Output, I/O, I/O	34	HA2	HA2	HA2	Input
3	NC	no pin	RDETIN1	NC, NC, Input	35	HD4	HD4	HD4	I/O
4	RINGD	no pin	RDETIN2	Input, NC, Input	36	HD5	HD5	HD5	I/O
5	no pin	no pin	ACOUT1	NC, NC, I/O	37	HD0	HD0	HD0	I/O
6	NC	no pin	ACOUT2	INC, NC, /O	38	HD1	HD1	HD1	I/O
7	TXA1	no pin	XFMR1	Output, NC, I/O	39	HD3	HD3	HD3	I/O
8	TXA2	no pin	XFMR2	Output, NC, I/O	40	~HCS	~HCS	~HCS	Input
9	RXA	no pin	RDET/CID	Input, NC, Input	41	HD6	HD6	HD6	I/O
10	no pin	no pin	no pin		42	no pin	no pin	no pin	
11	no pin	no pin	no pin		43	no pin	no pin	no pin	
12	no pin	no pin	no pin		44	no pin	no pin	no pin	
13	no pin	no pin	no pin		45	no pin	no pin	no pin	
14	no pin	no pin	no pin		46	no pin	no pin	no pin	
15	no pin	no pin	no pin		47	no pin	no pin	no pin	
16	no pin	no pin	no pin		48	no pin	no pin	no pin	
17	no pin	no pin	no pin		49	no pin	no pin	no pin	
18	no pin	no pin	no pin		50	no pin	no pin	no pin	
19	no pin	no pin	no pin		51	no pin	no pin	no pin	
20	no pin	no pin	no pin		52	no pin	no pin	no pin	
21	no pin	no pin	no pin		53	no pin	no pin	no pin	
22	no pin	no pin	no pin		54	VC	no pin	VC	Output, NC, Output
23	no pin	no pin	no pin		55	~VOICE	no pin	~VOICE	Output, NC, Output
24	~RESET	~RESET	~RESET	Input	56	~CALLID	no pin	~CALLID	Output, NC, Output
25	HA1	HA1	HA1	Input	57	LCS	no pin	LCS	Input, NC, Input
26	DGND	DGND	DGND	GND	58	TELOUT	no pin	TELOUT	Output, NC, Output
27	HD7	HD7	HD7	I/O	59	TELIN	no pin	TELIN	Input, NC, Input
28	~PULSE	~PULSE	~PULSE	Output	60	MICM	no pin	MICM	Input, NC, Input
29	HD2	HD2	HD2	I/O	61	VCC	VCC	VCC	POWER
30	HINT	HINT	HINT	Output	62	MICV	NC	MICV	Input, NC, Input
31	HA0	HA0	HA0	Input	63	AGND	AGND	AGND	GND
32	~HWT	~HWT	~HWT	Input	64	SPKR	SPKR	SPKR	Output

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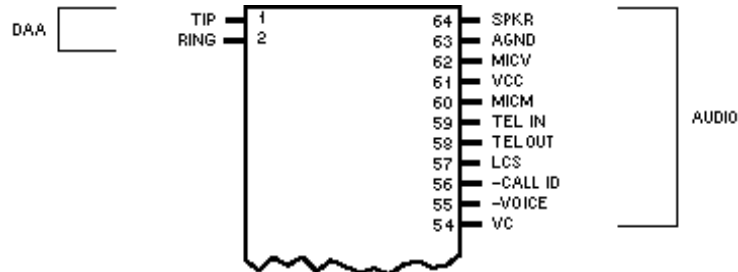


Note: Pins 3-9 and 54-60 are not installed

a. Standard Integrated DAA (D5 Option)

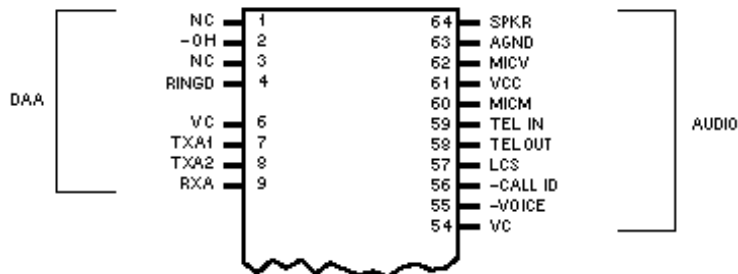


b. Full Functionality Integrated DAA (D6 Option)



Note: Pins 3-9 are not installed

c. Standard European DAA (DF, DG, DT, DE, DS and DB Options)



Note: Pin 5 is not installed

d. External DAA (D0 Option)

Figure 2-4. SFV144ACF, SFV336ACF and SFV56ACL DAA and Audio Pinouts

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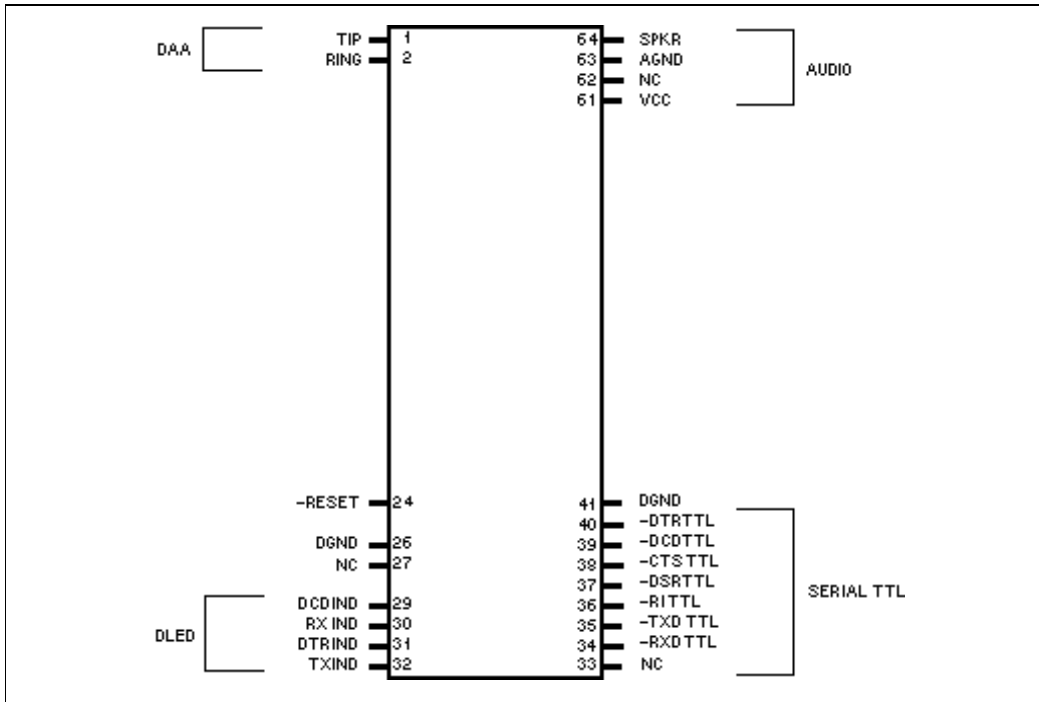


Figure 2-5. SF224ATF Serial TTL Pinout
(~ indicates active low)

Table 2-4. SF224ATF Serial TTL Signals

Pin	D5	I/O Type	Pin	D5	I/O Type
1	TIP	I/O	33	NC	NC
2	RING	I/O	34	~RXDTTL	Output
3	no pin		35	~TXDTTL	Input
4	no pin		36	~RITTL	Output
5	no pin		37	~DSRTTL	Output
6	no pin		38	~CTSTTL	Output
7	no pin		39	~DCDTTL	Output
8	no pin		40	~DTRTTL	Input
9	no pin		41	DGND	GND
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	
23	no pin		55	no pin	
24	~RESET	Input	56	no pin	
25	no pin		57	no pin	
26	DGND	GND	58	no pin	
27	NC	NC	59	no pin	
28	no pin		60	no pin	
29	DCDIND	Output	61	VCC	POWER
30	RXIND	Output	62	NC	NC
31	DTRIND	Output	63	AGND	GND
32	TXIND	Output	64	SPKR	Output

SocketModem SF Series Designer's Guide

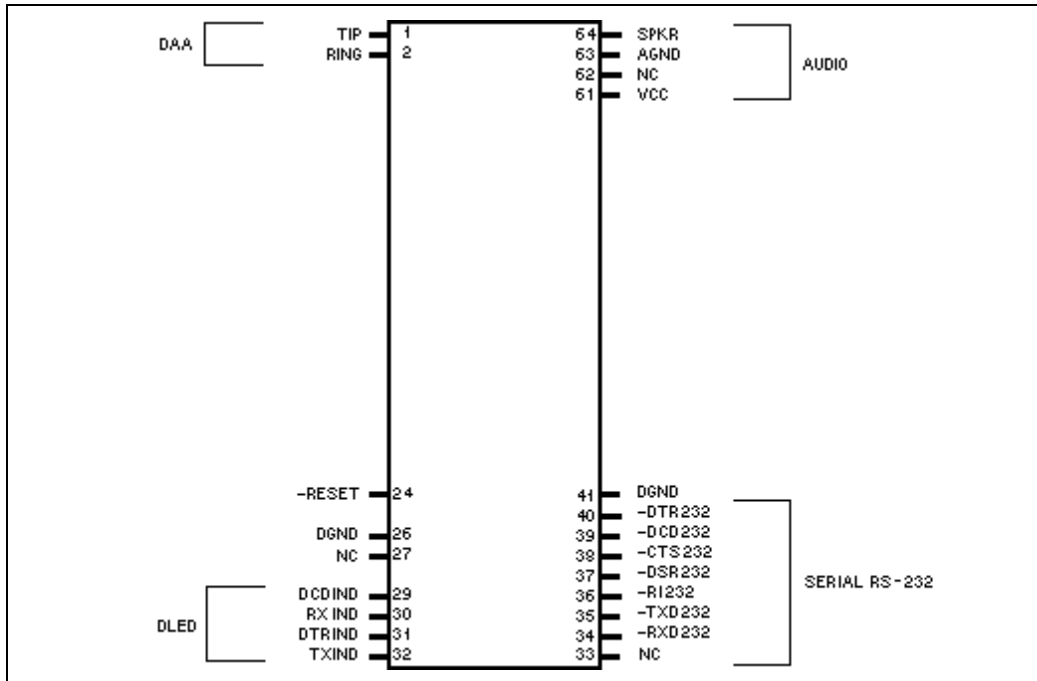


Figure 2-6. SF224ATF Serial EIA-232 Pinout
(~ indicates active low)

Table 2-5. SF224ATF Serial EIA-232 Signals

Pin	D5	I/O Type	Pin	D5	I/O Type
1	TIP	I/O	33	NC	NC
2	RING	I/O	34	~RXD _{TTL}	Output
3	no pin		35	~TXD _{TTL}	Input
4	no pin		36	~RIT _{TTL}	Output
5	no pin		37	~DSR _{TTL}	Output
6	no pin		38	~CTS _{TTL}	Output
7	no pin		39	~DCD _{TTL}	Output
8	no pin		40	~DTR _{TTL}	Input
9	no pin		41	DGND	GND
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	
23	no pin		55	no pin	
24	~RESET	Input	56	no pin	
25	no pin		57	no pin	
26	DGND	GND	58	no pin	
27	NC	NC	59	no pin	
28	no pin		60	no pin	
29	DCDIND	Output	61	VCC	POWER
30	RXIND	Output	62	NC	NC
31	DTRIND	Output	63	AGND	GND
32	TXIND	Output	64	SPKR	Output

SocketModem SF Series Designer's Guide

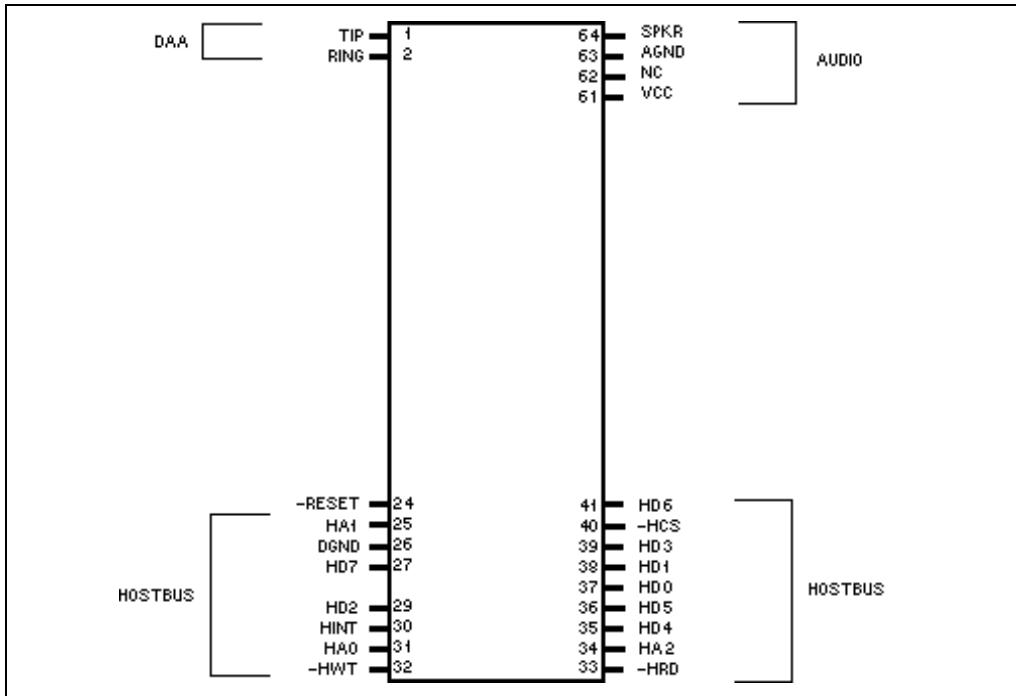


Figure 2-7. SF224ATF Host Parallel Pinout
(~ indicates active low)

Table 2-6. SF224ATF Host Parallel Signals

Pin	D5	I/O Type	Pin	D5	I/O Type
1	TIP	I/O	33	~HRD	Input
2	RING	I/O	34	HA2	Input
3	no pin		35	HD4	I/O
4	no pin		36	HD5	I/O
5	no pin		37	HD0	I/O
6	no pin		38	HD1	I/O
7	no pin		39	HD3	I/O
8	no pin		40	~HCS	Input
9	no pin		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	
23	no pin		55	no pin	
24	~RESET	Input	56	no pin	
25	HA1	Input	57	no pin	
26	DGND	GND	58	no pin	
27	HD7	I/O	59	no pin	
28	no pin		60	no pin	
29	HD2	I/O	61	VCC	POWER
30	HINT	Output	62	NC	NC
31	HA0	Input	63	AGND	GND
32	~HWT	Input	64	SPKR	Output

SocketModem SF Series Designer's Guide

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	IF	TIP Signal From Telco/PTT. If an on-board DAA is used, this pin is TIP signal from the Telco jack.
RING	IF	RING Signal From Telco/PTT. If an on-board DAA is used, this pin is RING signal from the Telco jack.
RXA	I(DA)	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).
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.
RINGD	IA	Ring Indicate. 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. If an on-board DAA is used, RINGDI is an active-high ring-indicator output. If an external DAA is used, RINGD is an active-high ring-indicator input.
~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. SFV336ACFW 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 <i>RCV336ACF/SP Designer's Guide</i> for details).

SocketModem SF Series Designer's Guide

Table 2-7. Signal Descriptions (Cont'd)

Label	I/O Type	Signal Name /Description
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.

SocketModem SF Series Designer's Guide

Table 2-7. 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.
GND	GND	Digital Ground.

SocketModem SF Series Designer's Guide

Table 2-7. Signal Descriptions (Cont'd)

Label	I/O Type	Signal Name /Description
LED driver lines are open-drain inverter-driven (74HCT05) lines with 1.5 K Ω , 1/10W pull-up resistors.		
DCDIND	OG	Active High DCD Status.
RXDIND	OG	Active High RXD Status.
DTRIND	OG	Active High DTR Status.
TXDIND	OG	Active High TXD Status.
SIGNALS UNIQUE TO THE SFV D6 OPTION		
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.
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 .
SPKR	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).		

SocketModem SF Series Designer's Guide

Table 2-8. Digital Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions ¹
Input High Voltage Type IA Type IC Type ID Type IH	V_{IH}	2 0.7 VCC 0.8 VCC -30	– – –	VCC VCC + 0.3 VCC + 0.3 30	Vdc	
Input Low Voltage Type IA, IC, and ID	V_{IL}	-0.3	–	0.8	Vdc	
Input Leakage Current RESET/	I_{IN}	–	–	±2.5	µADC	$V_{IN} = 0$ to VCC
Output High Voltage Type OA Type OD Type OG Type OH	V_{OH}	2.4 – – 5	– – – 8	– VCC VCC –	Vdc	$I_{LOAD} = -100 \mu A$ $I_{LOAD} = 0 mA$
Output Low Voltage Type OA Type OB Type OD Type OG Type OH	V_{OL}	– – – 0.5 -8	– – 0.75 – -5	0.4 0.4 – – –	Vdc	$I_{LOAD} = 1.6 mA$ $I_{LOAD} = 0.8 mA$ $I_{LOAD} = 15 mA$ $I_{LOAD} = 8 mA$
Three-State (Off) Current	I_{TSI}			±10	µADC	$V_{IN} = 0 V$
Circuit Type Type IA Type IC Type ID Type OA Type OD Type OG Type OH						TTL CMOS with pull-up -RES TTL with 3-state Relay driver LED Driver EIA/TIA-232
<p>Notes:</p> <p>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.</p>						

SocketModem SF Series Designer's Guide

Table 2-9. Analog Electrical Characteristics

Name	Type	Characteristic	Value
RXA	I (DA)	Input Impedance AC Input Voltage Range Reference Voltage	> 70K Ω 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 μ F 10 Ω 2.2 VP-P +2.5 VDC \pm 200 mV
SPKR	O (DF)	Minimum Load Maximum Capacitive Load Output Impedance AC Output Voltage Range Reference Voltage DC Offset Voltage	300 Ω 0.01 μ F 10 Ω 1.1 VP-P +2.5 VDC \pm 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 < 500 mA \leq -9.5 dBm
TIP RING	IF	Ring Detect Sensitivity Ring Detect Peak Current Ring Detect Idle Current Loop Current Ring Equivalency Number (REN)	> 38 V _{RMS} > 100 μ V < 50 nA < 100 mA 1.0 Bel

SocketModem SF Series Designer's Guide

2.4 FIRMWARE ROM

SocketModem firmware performs processing of general modem control, command sets, error correction, data compression, MNP 10, fax Class 1, voice, audio, RPI, and DTE interface functions depending on the modem model. The SocketModem firmware is programmed into the on-board ROM by Rockwell. On-board flash EEPROM may be reprogrammed via the flash-download process (except SF224ATF). The ROM onboard is 128Kx8 Flash EEPROM (except SF224ATF).

2.5 DAA INTERFACE

The SocketModem is configured to be an on-board DAA (D5, D6, or European 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. For D5, and D6 SocketModems, use the appropriate telco interface circuitry to meet the FCC/DOC requirements. This circuitry shown in Figure 2-8 and Figure 2-9. New FCC surge requirements are pending for PART 68 testing. Figure 2-8 shows the configuration which can be currently used to pass FCC Part 68. When the new surge requirements take affect the circuitry in Figure 2-9. will be needed to pass FCC Part 68. The FCC has not given a firm date to when the new surge requirement will take affect.

When using any of the European SFV336ACF SocketModems, (DF, DG, DT, DE, DB), provide TIP and RING signals from the telco jack to pins 1 and 2 of the SocketModem. Only EMI suppression components may be used. If other components are used, the PTT certification for these SocketModems will no longer apply, and recertification will be required. The recommended telco interface for European SFV336ACF SocketModems is shown in Figure 2-10. The same layout for the U.S. components can be used by removing the MOV, replacing the 18.2 ohm resistors with 0 ohm jumpers and changing the capacitors to a 3000 volt rating. TIP and RING signal traces are to be no closer than 0.062" from any other traces for U.S. applications. TIP and RING signal traces are to be no closer than 2.5mm (0.1") from any other traces for European applications. 2.5mm spacing must be used if the host board is to support both U.S. and European Socket Modems.

A recommended design of an external DAA suitable for use in the USA or Canada 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 DAA bill of materials is listed in Table 2-10.

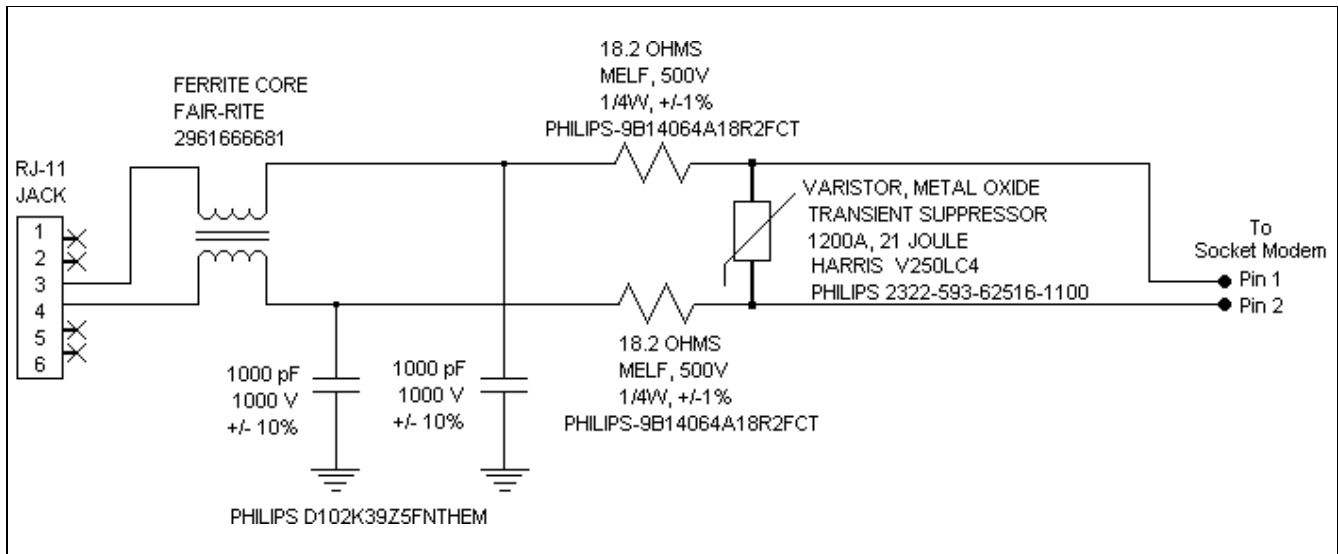


Figure 2-8. Example of DAA Interface for SocketModems with Self-Contained U.S. DAAs (D5 and D6 Options)

SocketModem SF Series Designer's Guide

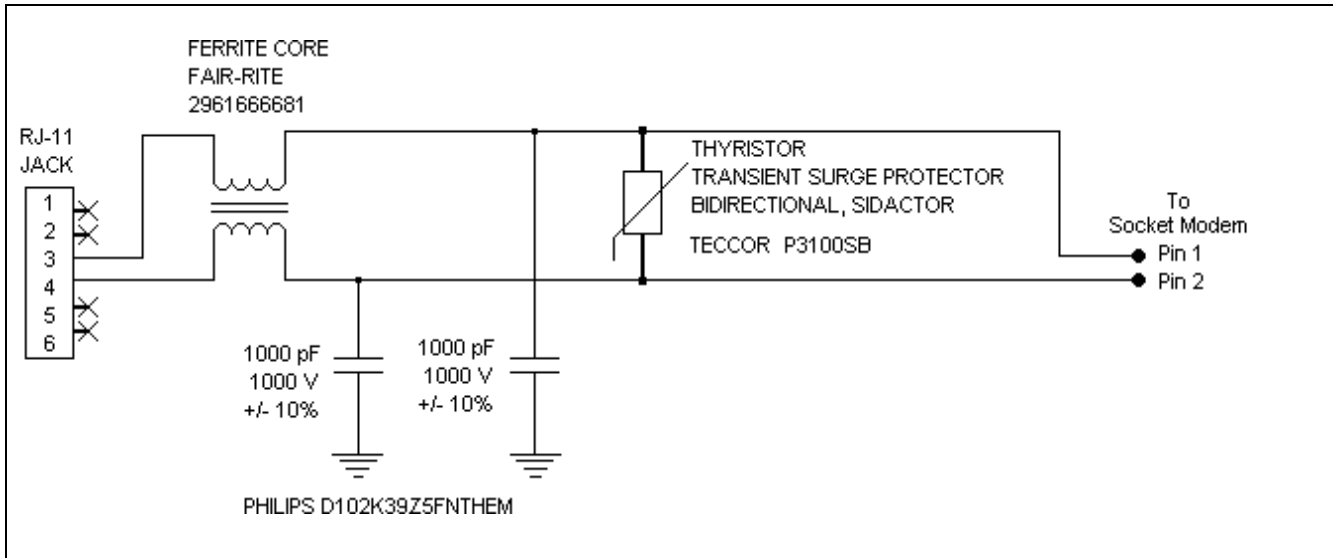


Figure 2-9. Example of DAA Interface for SocketModems with Self-Contained U.S. DAAs (D5 and D6 Options)

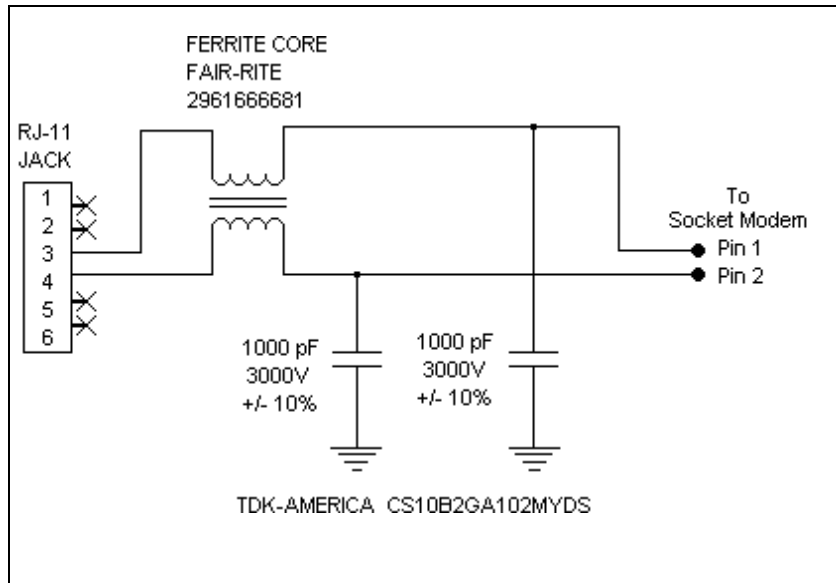


Figure 2-10. Recommended Telco Interface for European SocketModems (DF, DG, DT, DE and DB Options)

SocketModem SF Series Designer's Guide

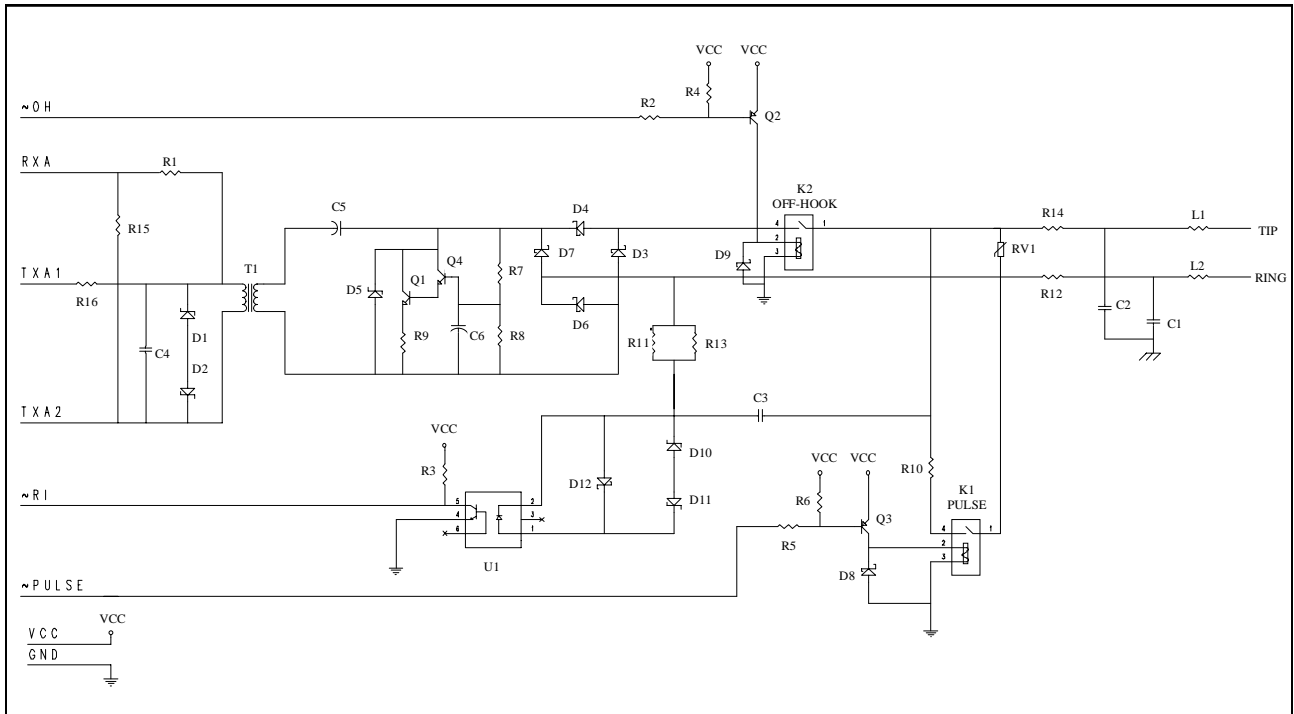


Figure 2-11. External DAA Example

SocketModem SF Series Designer's Guide

Table 2-10. External 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, 5.23K Ω , 1%, 1/8W, Film
1	R2	Resistor, 3.3K Ω , 5%, 1/8W, Carbon
1	R3	Resistor, 100K Ω , 5%, 1/8W, Carbon
2	R4, R6	Resistor, 27K Ω , 5%, 1/8W, Carbon
1	R5	Resistor, 4.7K Ω , 5%, 1/8W, Carbon
1	R7	Resistor, 40.2K Ω , 1%, 1/4W, Film
1	R8	Resistor, 18.7K Ω , 1%, 1/8W, Film
1	R9	Resistor, 10 Ω , 1%, 1/8W
1	R10	Resistor, 120 Ω , 1/2W
2	R11, R13	Resistor, 15K Ω , 5%, 1/4W
2	R12, R14	Resistor, 18 Ω , 5%, 1/2W, 500V
1	R15	Resistor, 10.0K Ω , 1/8W
1	R16	Resistor, 523 Ω , 1/8W
1	RV1	Varistor, V250LC4, 250VRMS
1	T1	Transformer, Midcom 671-8262
1	U1	Optoisolator, 4N35

SocketModem SF Series Designer's Guide

2.5.1 ~PULSE Filter Circuit

On the SFV SocketModems, 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 to the ~PULSE relay. Refer to the *RCV336ACF/SP Modem Designer's Guide* for details.

This circuit is included in the European SFV336ACF SocketModems.

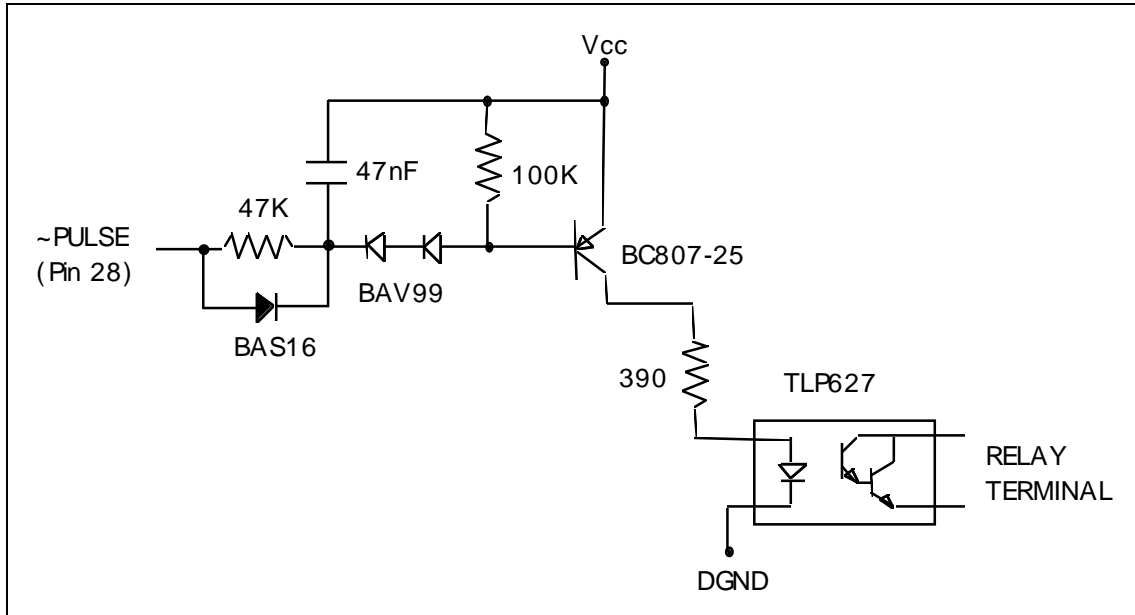


Figure 2-12. ~PULSE Filter Circuit

2.5.2 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 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 an audio amplifier. The 10 μF capacitor between pin 1 and pin 8 of the amplifier bypasses internal circuitry to achieve the maximum gain. The second 10 μF capacitor, between pin 5 of the amplifier and the Sounducer, is used to keep the 2.5 VDC bias of the op amplifier from going into the Sounducer.

In Figure 2-14, the audio amplifier drives a 8 Ω speaker. In this circuit, the amplifier's bypass circuit includes a 750 Ω resistor, and the bias-blocking capacitor changes to 22 μF .

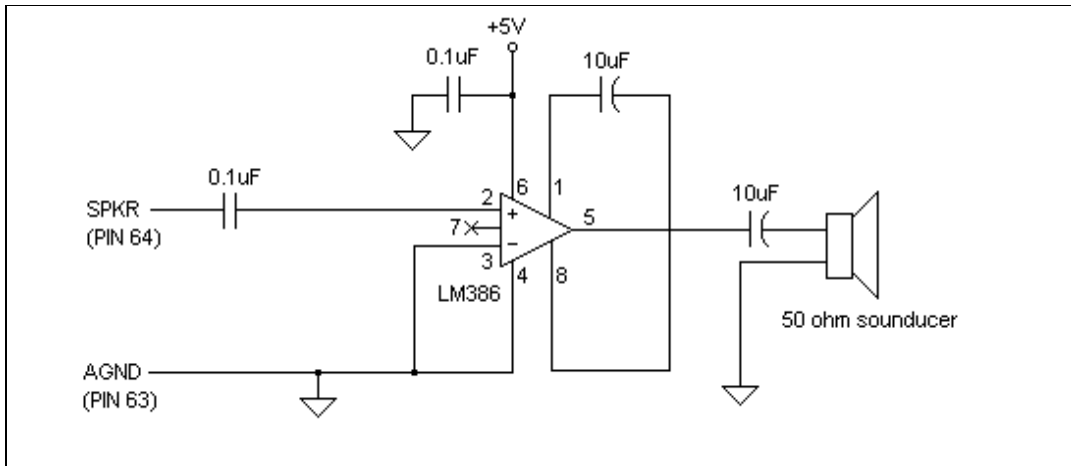


Figure 2-13. Sounducer Driver Circuit

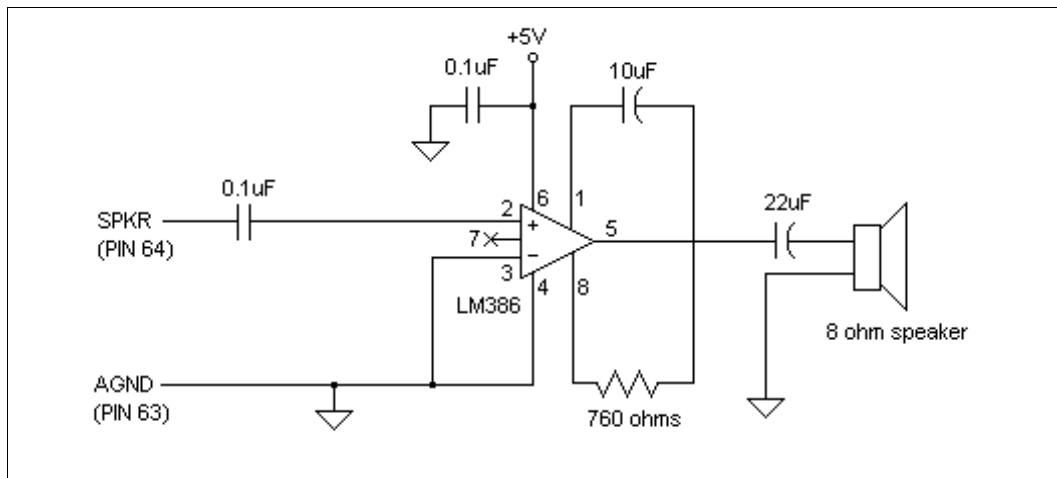


Figure 2-14. Speaker Driver Circuit

SocketModem SF Series Designer's Guide

2.5.3 SFV336ACFW Telephone Line/Telephone/Audio Interface

Figure 2-15 shows the circuitry used on the Socket Modem Demo boards to implement audio and speaker phone functions.

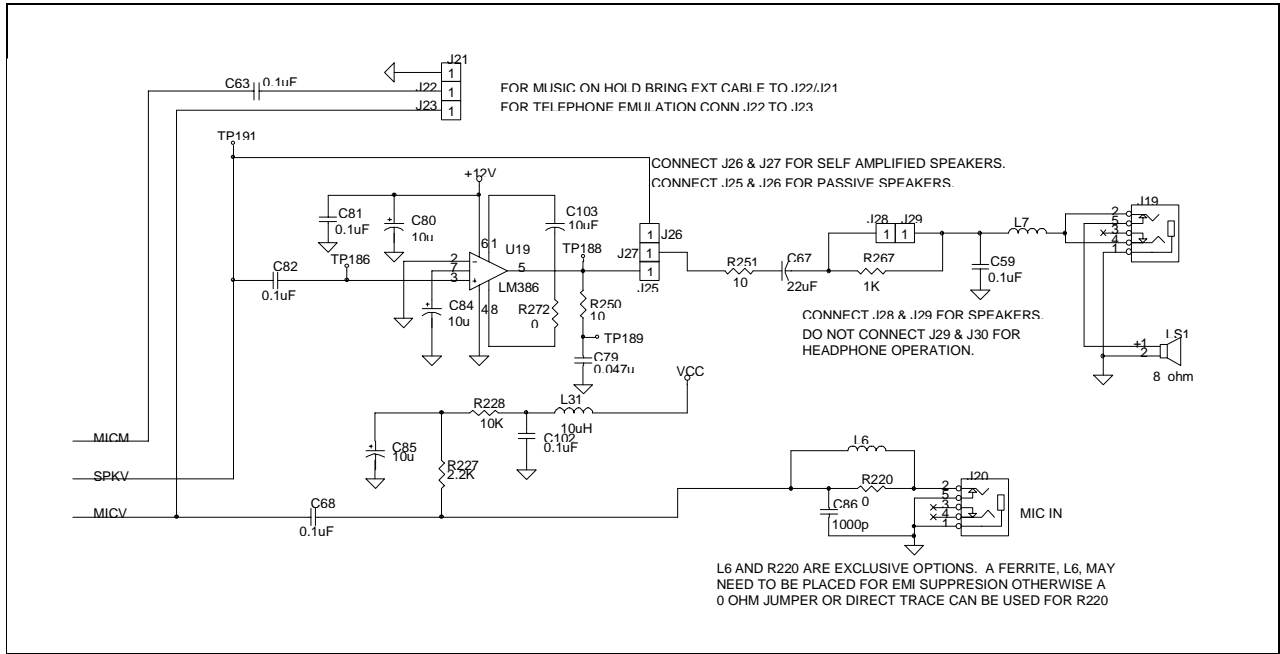


Figure 2-15. Audio Circuitry for Audio and Speaker Phone operation

SocketModem SF Series Designer's Guide

Figure 2-16 outlines the complete DAA circuit for the SFV Socket Modem configured for the -D6 DAA interface.

Figure 2-17 describes the supporting DAA and audio handset circuitry used on the TE28-D400, TE28-D500 and TE28-D550 SocketModem Evaluation Boards.

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

For D6 option Socket Modems, the primary windings of the transformer are routed to the SocketModem pins XFMR1 and XFMR2 (Pins 7 and 8), where they are connected to the inputs of a DPDT relay controlled by \sim CALLID. During normal operation, and when Caller ID is disabled, XFMR1 and XFMR1 are connected back to the SocketModem on ACOUT1 and ACOUT2 (Pins 5 and 6). ACOUT1 and ACOUT2 connect to a full-wave bridge, current-holding circuit and off-hook relay, the output of which goes to TIP and RING (Pins 1 and 2). 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 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 reserved so that they may be included at assembly time should EMI test results call for them. If the ferrite beads are not needed, install two zero Ω resistors (jumpers) instead.

If Caller ID is enabled, \sim 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, through a $0.33\ \mu\text{F}$ 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 $0.33\ \mu\text{F}$ capacitor normally used by the ring-detect circuit to provide DC-blocking while preventing drawing sufficient current to seize the line.

The D6 option Socket Modem can also be configured to be permanently AC coupled to the telephone line. This allows the Caller ID function to be performed without the need for a relay. To implement permanent AC coupling to the line place a $0.1\ \mu\text{F}$ 200V capacitor and 18 ohm resistor in series between the Socket Modem pins 2 and 7. Also place a $0.1\ \mu\text{F}$ 200V capacitor between Socket Modem pins 1 and 8.

Detection of an incoming ring signal is performed by connecting TIP to RDETIN1, and RING to RDETIN2 (Pins 3 and 4 of the Socket Modem). 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 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, which may then enable or disable certain modem features depending on its run-time configuration.

The Voice relay, controlled by the \sim VOICE signal from the RCV336ACF, 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. \sim 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.

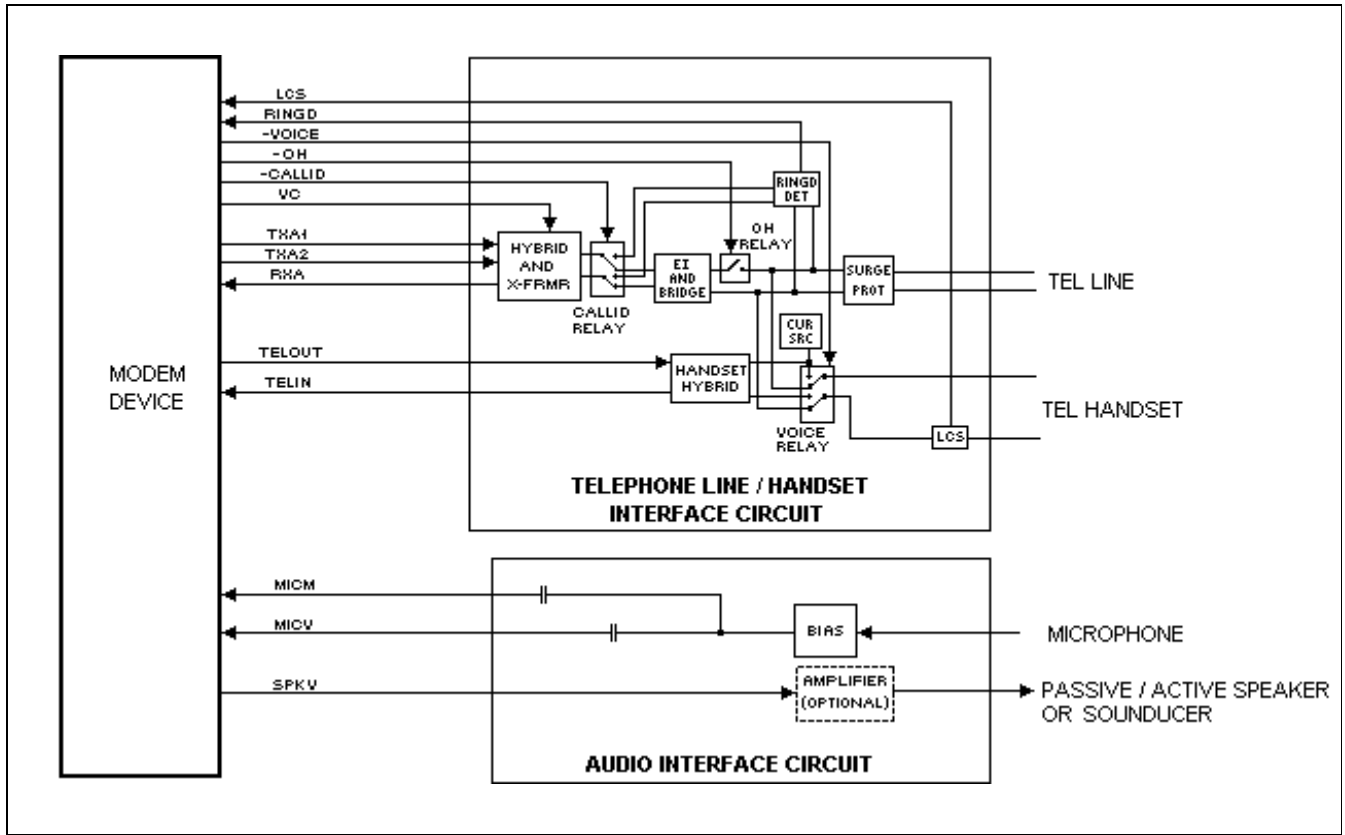


Figure 2-16. SFV336ACF Telephone Line/Telephone/Audio Interface Circuit

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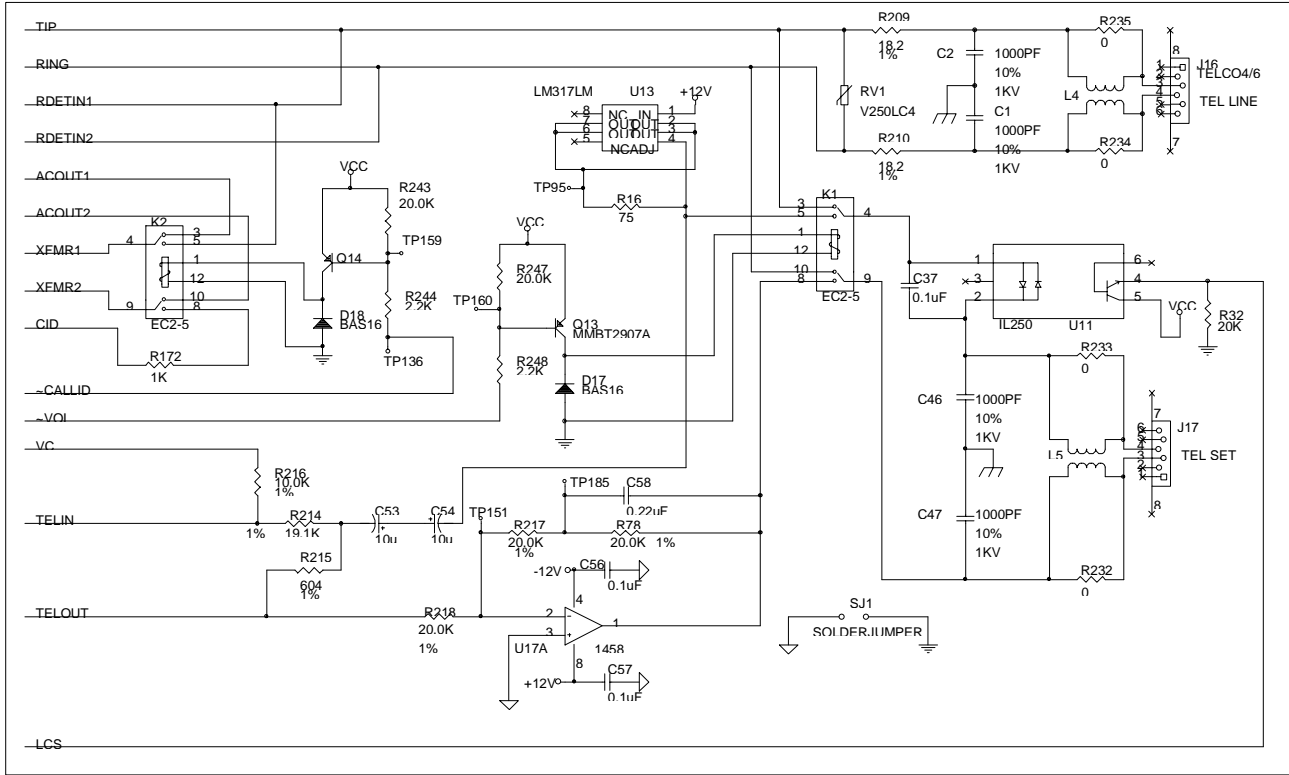


Figure 2-17. SF336ACF Telephone Line/Telephone Handset/Audio Interface Circuit: D6 Option

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.

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 for U.S. applications. TIP and RING signal traces are to be no closer than 2.5mm (0.1") from any other traces for European applications. 2.5mm spacing must be used if the host board is to support both U.S. and European Socket Modems.

3.1.2 Electromagnetic Interference (EMI) Considerations

The following guidelines are offered to specifically help minimize EMI generation. Some of these guidelines are the same as, 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.

SocketModem SF Series Designer's Guide

4. Eliminate ground loops, which are unexpected current return paths to the power source and ground.
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.

SocketModem SF Series Designer's Guide

3.2 PRODUCT MIGRATION GUIDELINES

The SocketModem products are pin-compatible across families. A host board designed initially for the SF144ACF HxD5A0P1, for example, can readily support a SF224ATF HxD5A0P1, a SF336ACF HxD5A0P1, or a SF56AFL HxD5A0P1.

- If planning to migrate from a U.S. D5 option Socket Modem to a European Socket Modem, design the host board to accommodate for the European option. Pins 54-60 are not present on the U.S. D5 option Socket Modem, but are located on the European Socket Modem.

3.3 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 to a cable with a DB-9 or a DB-25 connector on the other end.

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. If the modem is to be connected back-to-back by cable directly to another modem, the modems will not operate. The DAAs must be modified to operate dry, i.e., without line current, when used in this environment.

Rockwell has tested each of the European SFV336ACF SocketModems for compliance with their respective country's PTT requirements and has received PTT certificates that cover, without additional expense to the user, all applications that use these SocketModems in their respective countries. The certificates apply only to designs that route TIP and RING (pins 1 and 2) directly to the telco jack. Only specified EMI filtering components are allowed on these two signals as shown in figure 2-10.

3.4 MANUFACTURING CONSIDERATIONS

The Socket Modem has been designed to be mounted onto the host board in one of two ways.

The first method consists of soldering two 32 pin strip sockets to the host board and inserting the Socket Modem into the sockets. A suggested part number for the 32 pin socket is SamTec SMM-132-01-F-S. In order to pass FCC Part 68 and DOC voltage surge requirements, it is suggested that the pin at location 10 in the socket be removed between the DAA section (pins 1-9) of the Socket Modem and the remaining pins of the socket.

The second way is to solder the Socket Modem directly to the host board. The most efficient way to do this is through a wave solder process. The recommended hole size for the Socket Modem pins is 0.036 in. +/-0.003 in. in diameter. Spacers can be used to hold the Socket Modem vertically in place during the wave solder process. A spacer should be placed on pin 32 and pin 64 of the Socket Modem. A suggested part number for the spacer is BIVAR 938-0.130 for P1(0.310in) option Socket Modems. The spacers can be left on permanently and will not effect operation.

The SFV144ACF, SFV336ACF and SFV56ACL Socket Modems can all be put through a water wash process. The SF224ATF Socket Modem can not be put through a water wash process.

SocketModem SF Series Designer's Guide

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SocketModem SF Series Designer's Guide

4. PACKAGE DIMENSIONS

Package dimensions are shown in Figure 4-1 (SF224ATF), Figure 4-2 (SF144ACF, SF336ACF and SF56ACL), and Figure 4-3. (European Socket Modem Physical Dimensions - SFV144ACF, SFV336ACF with DF, DG, DT, DE and DB options).

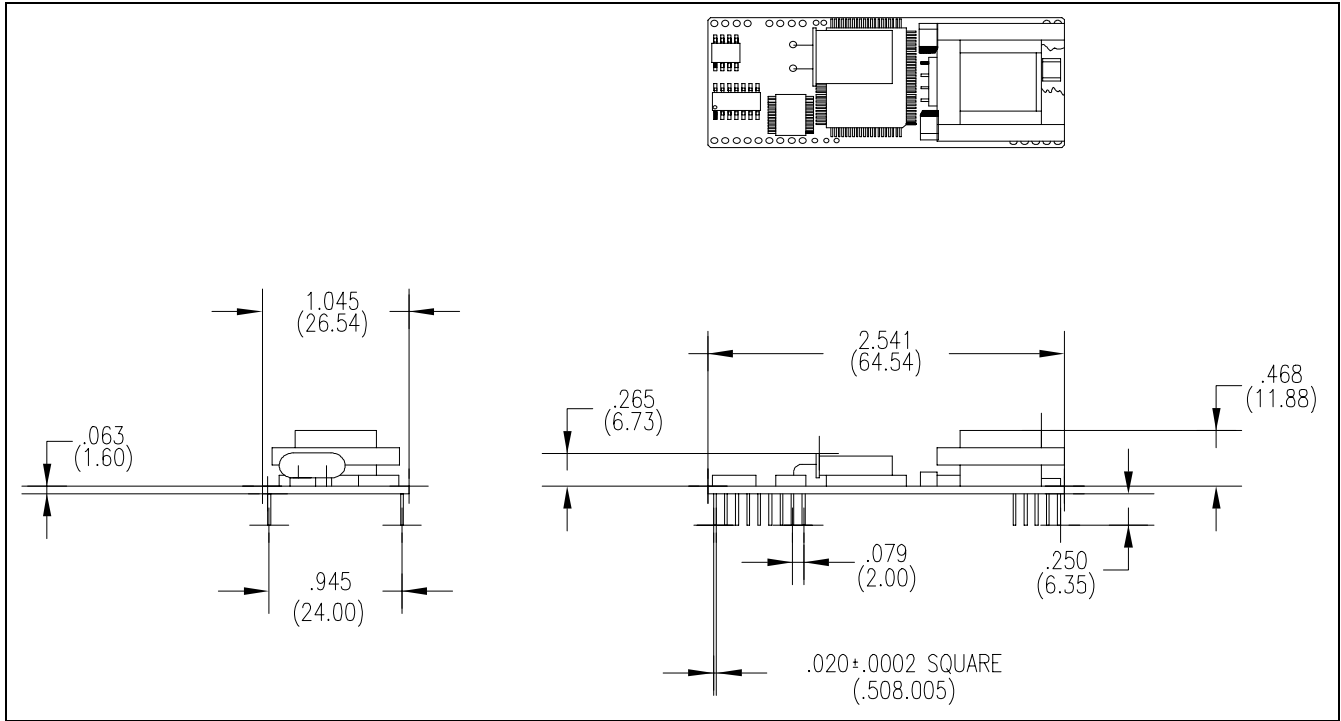


Figure 4-1. SocketModem Physical Dimensions - SF224ATF

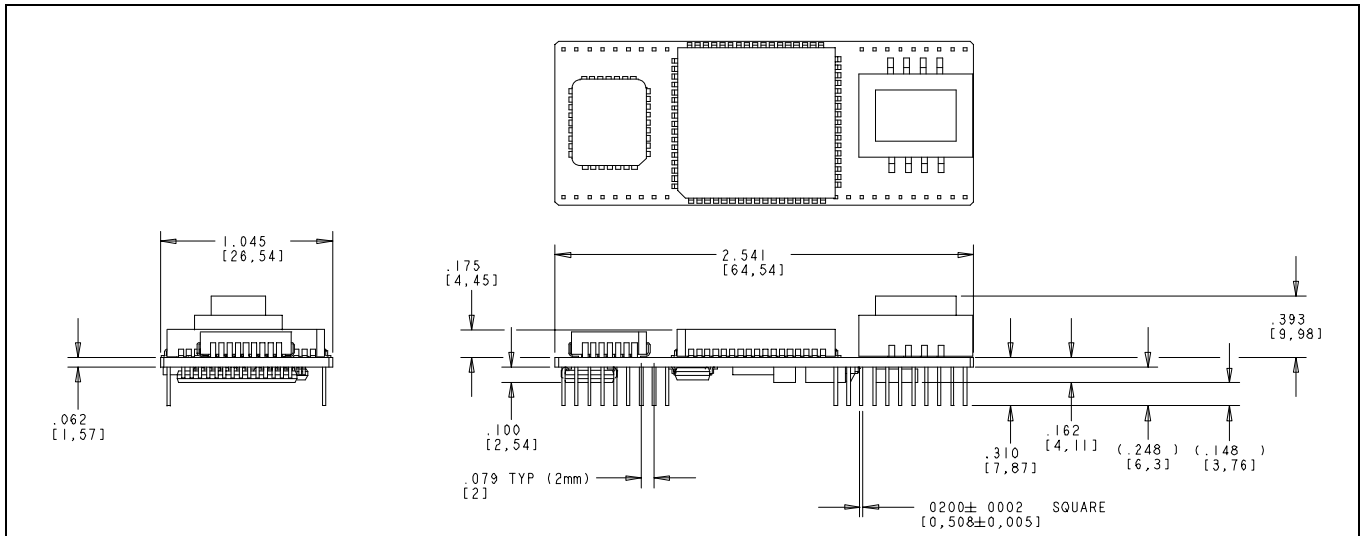


Figure 4-2. SocketModem Physical Dimensions - SFV144ACF, SFV336ACF and SFV56ACL (D5 and D6 Options)

SocketModem SF Series Designer's Guide

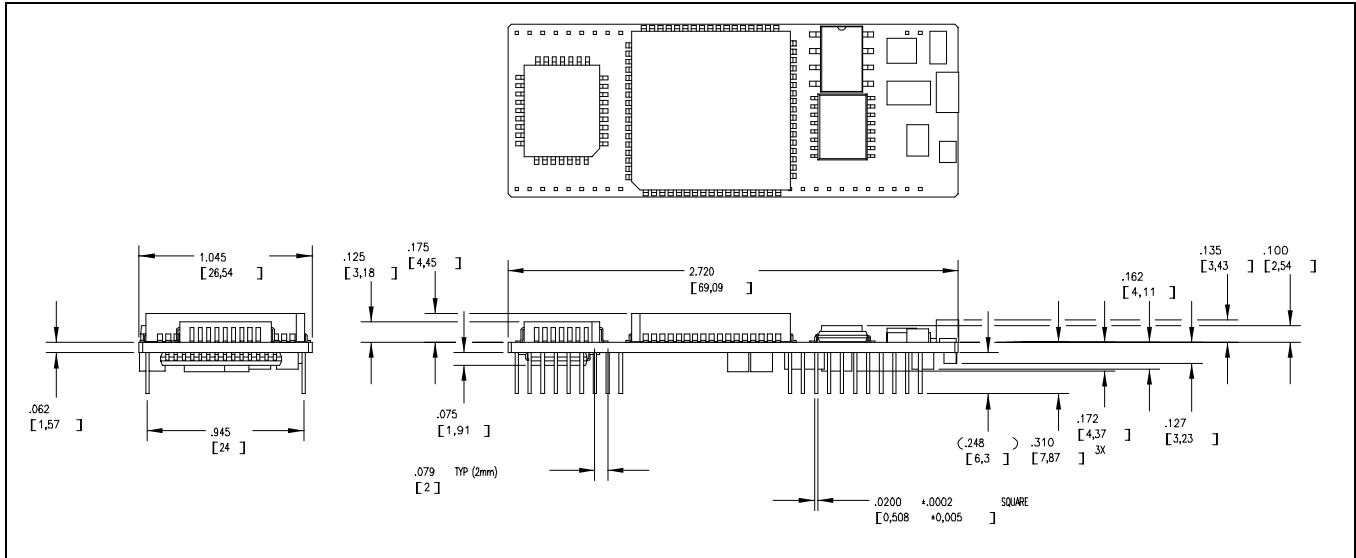


Figure 4-3. European Socket Modem Physical Dimensions - SFV144ACF, SFV336ACF (DF, DG, DT, DE and DB Options)

5. SOCKETMODEM DESIGN WITH SERIAL INTERFACE

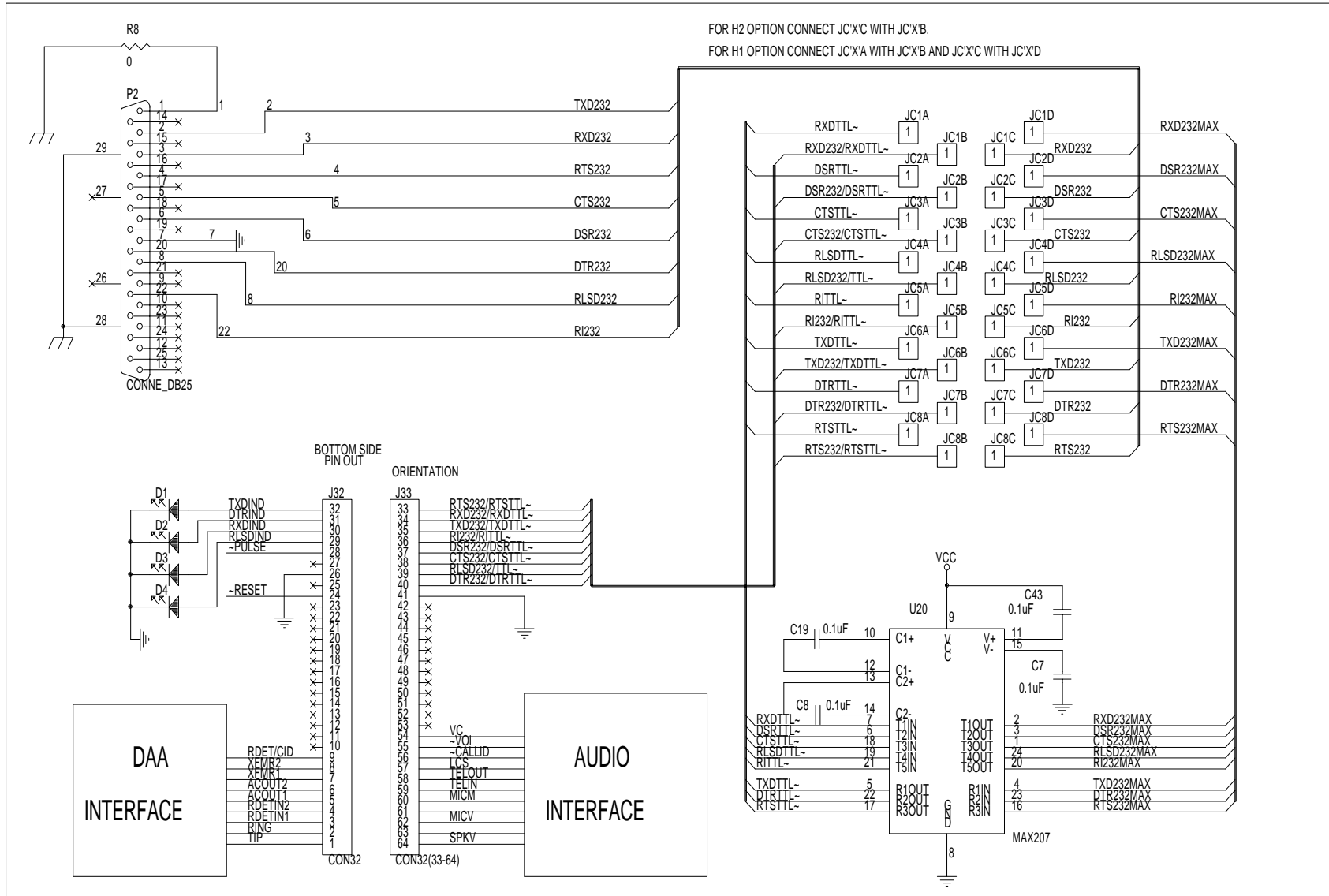


Figure 5-1. Serial Interface Example

SocketModem SF Series Designer's Guide

Table 5-1. Serial Interface Example Bill of Materials

Quantity	Reference	Part
4	C7, C8, C19, C43	Capacitor, 0.10uF, 25V, 20%, Ceramic
4	D1, D2, D3, D4	LED
2	J32, J33	Socket, 32-pin, 2mm SIP (SamTec SMM-132-01-F-S)
1	P2	Connector, DB-25; DB-9 can also be used
1	U20	RS-232 Converter (Maxim MAX207)

6. SOCKETMODEM DESIGN WITH PARALLEL INTERFACE

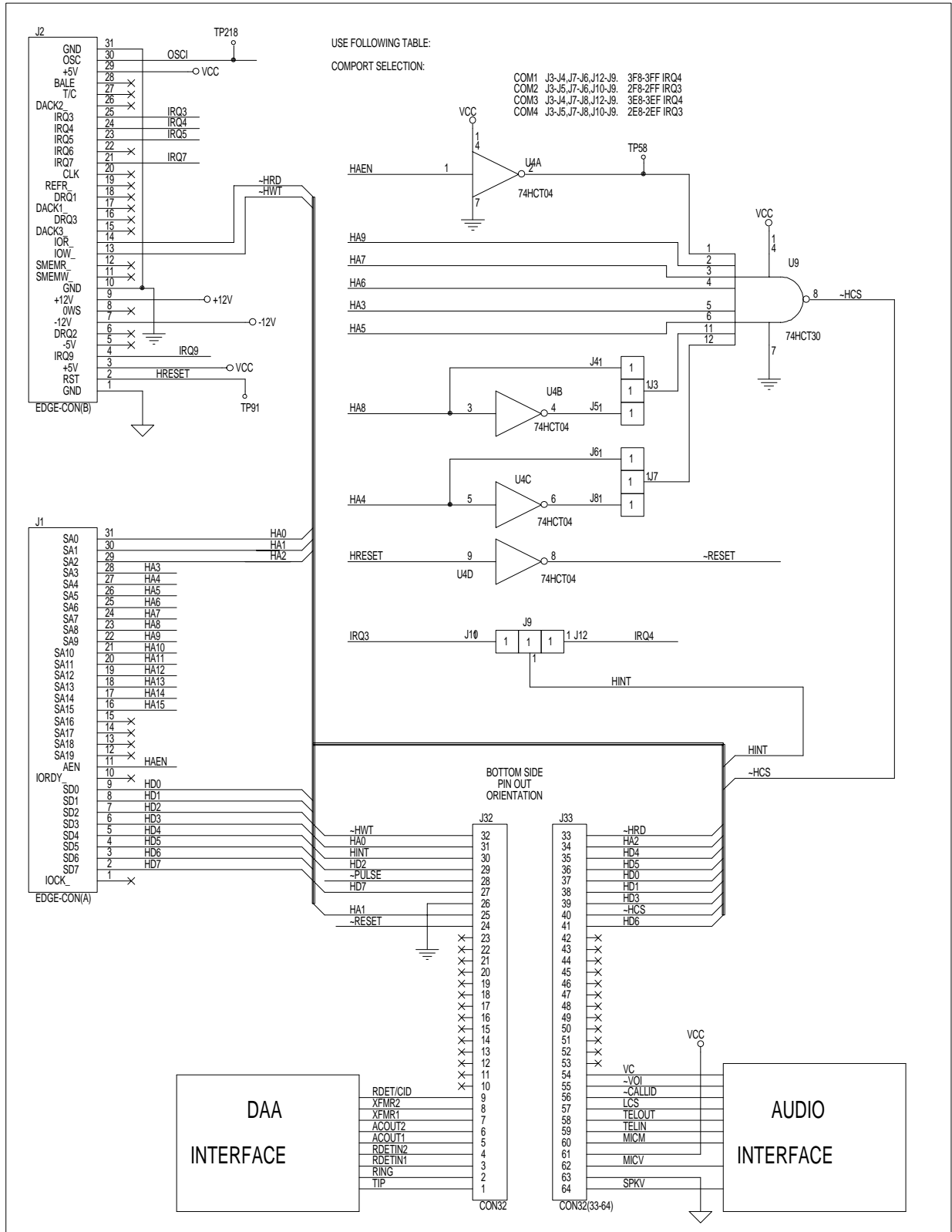


Figure 6-1. General-Purpose Parallel Interface

SocketModem SF Series Designer's Guide

Table 6-1. Parallel Interface Example Bill of Materials

Quantity	Reference	Part
2	J32, J33	Socket, Single Row, 2mm, 32-pin (SamTec SMM-132-01-F-S)
1	U4	74ALS04, Hex Inverter
1	U9	74LS30, 8-Input Positive NAND Gate

7. EUROPEAN SOCKETMODEM INSTALLATION GUIDELINES

The European SocketModem module is approved as a host-independent modem card. To maintain type approvals, permits and/or licenses valid, the guidelines described in this document must be followed.

7.1 CONSIDERATIONS FOR TELECOM APPROVALS

7.1.1 PSTN Connection

The European SocketModem can be connected to the Public Switched Telephone Network (PSTN) either

- a) by using a 2-wire flying cable to connect pins J1 and J2 of the card to an RJ-11 connector which can be assembled in a suitable location of the host system enclosure,

OR

- b) by providing traces on the host system motherboard for the PSTN connection signals (TIP and RING) between the card and an RJ-11 connector

If connection option a) is used, the cable and its installation inside the host system must be in accordance with the guidelines in IEC950/EN60950 (e.g. the insulation material must withstand electric strength tests as described in section 2.3).

If connection option b) is used, NO additional components except those used for EMI filtering (specified in figure 2-10) must be connected to the TIP and RING signals. Other components not intended for use with this design may affect the network access characteristics of the modem and may therefore invalidate the type approvals, permits and/or licenses.

In both cases, for the connection between the host and the PSTN wall connector, a cable with RJ-11 modular jack and an appropriate national plug must be used. Note that in Germany, an F-coded connector/plug must be used (this is one of the two typical plugs used for PSTN connection in Germany, the other type is called N-coded).

7.2 CONSIDERATIONS FOR ELECTRICAL SAFETY

7.2.1 Conditions for Maintaining Safety Compliance

The European SocketModem has been assessed with respect to electrical safety and has been found to comply with relevant standards as defined by the European Low Voltage Directive (73/23/EEC). The particular standard is EN 60950:1992 +A1/A2:1993 +A3:1995.

The card is rated as a Class III equipment and it is intended for use in Pollution Degree 2 environments only. Material Group IIIa or IIIb (Comparative Tracking Index below 400 according to IEC 112, method A) is assumed for any host system PCB that has traces and/or circuitry with TNV potential.

It is assumed that the modem card will only be assembled in a host system unit that complies with IEC950/EN60950.

Some particular requirements are:

- the host system must have a compliant fire enclosure (e.g. made of material with flammability class 94V-1 or better).
- the power supply unit of the host system must have double or reinforced insulation.

7.2.2 Power Supply

Before installing the European SocketModem in a host system, the installer must ensure that the power drawn by the card, together with the host and any auxiliary cards drawing power from the host, is within the rating of the host power supply unit.

The European SocketModem's power consumption is max 2.0 W (+5 Vdc).

7.2.3 Clearances, Creepage Distances and Distances through Insulation

The card must be installed such that with the exception of the connections to the host, clearance and creepage distances shown in the table below are maintained between

- a) the TNV area of the card (the DAA) and conductive parts of other assemblies inside the host,
- b) if applicable, the PSTN connection traces (TIP and RING) routed through the host system motherboard and any other conductive area (i.e. traces, through holes, SMD pads, copper areas, etc.) on that motherboard.

which use or generate a voltage shown in the table below:

Clearance (mm)	Creepage (mm)	Voltage used or Generated by Host or Other Cards
2.0	2.4 (3.8)	Up to 50 Vrms or Vdc
2.6	3.0 (4.8)	Up to 125 Vrms or Vdc
4.0	5.0 (8.0)	Up to 250 Vrms or Vdc
4.0	6.4 (10.0)	Up to 300 Vrms or Vdc

The larger distances shown in brackets applies for Pollution Degree 3 environments (where the local environment within the host is subject to conductive pollution or dry non-conductive pollution, which could become conductive due to expected condensation).

The same clearance and creepage distances also apply between TNV areas of the card and earth connections inside the host system.

Failure to maintain these minimum distances would invalidate the approval.

NOTE: For a host or other expansion cards fitted in the host using or generating voltages greater than 300 V (rms or dc), *advice from a competent telecommunications safety engineer must be obtained.*

If these clearance and creepage distances cannot be provided inside the host due to space limitations, a dielectric material may be used as a physical insulation barrier. The dielectric material used in this insulation must have a thickness of at least 0.4mm. If thinner dielectric material is used, at least two layers (sheets) must be used with each layer withstanding electric strength test using 3000 Vac (or 4242 Vdc).

SocketModem SF Series Designer's Guide

After installation (or implementation) of the European SocketModem inside a host system, it is recommended that a competent telecommunications safety engineer inspects the complete system to ensure that safety compliance is maintained.

(TNV = Telecommunications Network Voltages).

7.3 CONSIDERATIONS FOR EMC

7.3.1 EMC Compliance

The European SocketModem has been assessed with respect to emission of and immunity to electromagnetic disturbances and has been found to comply with the relevant harmonized standards as defined by the European EMC Directive (89/336/EEC).

These standards are

- Generic emission standard EN 50081-1:1992, which refers to
EN 55022:1994 +A1:1995, Class B
- Generic immunity standard EN 50082-1:1992, which refers to
 - IEC 801-2:1984 Electrostatic discharge requirements
 - IEC 801-3:1984 Radiated electromagnetic field requirements
 - EN 61000-4-4:1995 Electrical fast transient/burst requirements

7.3.2 Installation in Host Systems

It is assumed that the European SocketModem will only be assembled in host systems that comply with the EMC Directive.

As per definition of the EMC Directive, the card and its host system will constitute an "installation" similar to e.g. a PC card modem installed in a personal computer. Therefore, if the host system complies with the EMC Directive, there should be no need for verifying continued compliance of the complete system.

However, note that it is the responsibility of the professional installer of European SocketModem to ensure that the complete system placed on the market complies with the Directive.

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