-Using Clarinet for Analog Measurement -

1. INTRODUCTION

The data in any B-channel (basic or primary rate) can be directed to the analog/digital ports on the ISDN pod, or to the digital port (TRANSDATA interface).

These interfaces can be used as:

- permanent connections (Data Link, TRANSDATA, TRANSIT or the two Cofidec interfaces). The permanent connections are initialised upon profile launching and set for the entire duration of the profile.

- switched connections established by the Q931 simulator for outgoing and incoming communications.

2. ANALOG PORT

Main Characteristics:

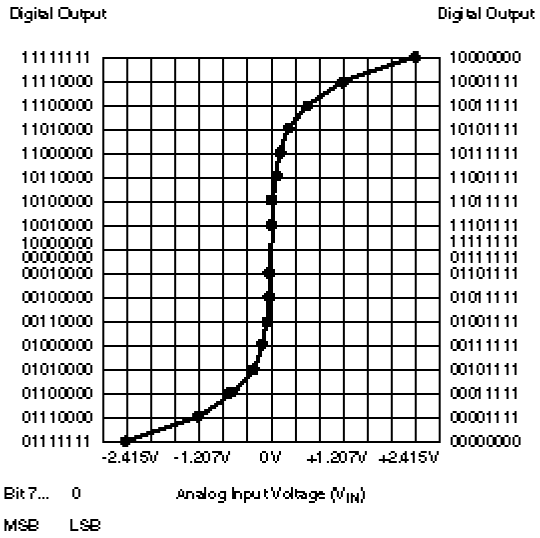
- input impedance ≥ 100kΩ

- output level 0dB, on a 600Ω resistive load

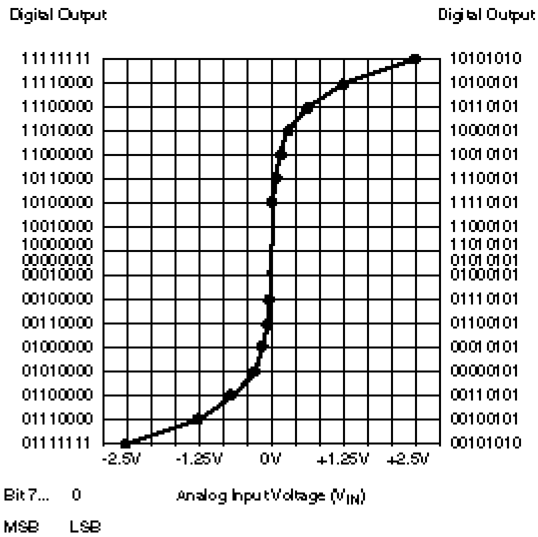
The analog port uses standard integrated filter Cofidec from Mitel (MT8965 for A-Law). But the analog I/O lines are routed through an analog switch array and output buffers which can introduce little additional distortion. Unfortunately, ACACIA doesn't provide any global performance data-sheet about analog I/O port because only functional tests are done during manufacturing.

The characteristics of the Cofidec are given hereafter:

- μ law Transfer Characteristic:



- A law Transfer Characteristic:



AC Electrical Characteristics - Transmit (A/D) Path - Voltages are with respect to GNDD unless otherwise stated.
T_A=0 to 70°C, V_{DD}=5V±5%, V_{EE}=-5V±5%, V_{Ref}=2.5V±0.5%, GNDA=GNDD=0V, Clock Frequency = 2.048MHz,
Filter Gain Setting = 0dB. Outputs unloaded unless otherwise specified.

		Characteristics	Sym	Min	Typ*	Max	Units	Test Conditions
1		Analog Input at V_X equivalent to the overload decision level at the codec	V_{IN}		4.829 5.000		V_{PP} V_{PP}	Level at codec: µ-Law: 3.17 dBm0 A-Law: 3.14 dBm0 See Note 6
2		Absolute Gain (0dB setting)	G_{AX}	-0.25		+0.25	dB	0 dBm0 @ 1004 Hz
3		Absolute Gain (+1dB to +7dB settings)		-0.35		+0.35	dB	from nominal, @ 1004 Hz
4		Gain Variation — With Temp	G_{AXT}		0.01		dB	T_A=0°C to 70°C
		With Supplies	G_{AXS}		0.04		dB/V	
5	A N A L O G	Gain Tracking (See Figure 12) — CCITT G712 (Method 1)	GT_{X1}	-0.25 -0.25 -0.50		+0.25 +0.25 +0.50	dB dB dB	Sinusoidal Level: +3 to -20 dBm0 Noise Signal Level: -10 to -55 dBm0 -55 to -60 dBm0
		CCITT G712 (Method 2) AT&T	GT_{X2}	-0.25 -0.50 -1.50		+0.25 +0.50 +1.50	dB dB dB	Sinusoidal Level: +3 to -40 dBm0 -40 to -50 dBm0 -50 to -55 dBm0
6		Quantization Distortion (See Figure 13) — CCITT G712 (Method 1)	D_{QX1}	28.00 35.60 33.90 29.30 14.20			dB dB dB dB dB	Noise Signal Level: -3 dBm0 -6 to -27 dBm0 -34 dBm0 -40 dBm0 -55 dBm0
		Quantization Distortion (cont'd) (See Figure 13) — CCITT G712 (Method 2) AT&T	D_{QX2}	35.30 29.30 24.30			dB dB dB	Sinusoidal Input Level: 0 to -30 dBm0 -40 dBm0 -45 dBm0
7		Idle Channel Noise — C-message	N_{CX}			18	dBrnC0	µ-Law Only
		Psophometric	N_{PX}			-67	dBm0p	CCITT G712
8		Single Frequency Noise	N_{SFX}			-56	dBm0	CCITT G712
9		Harmonic Distortion (2nd or 3rd Harmonic)				-46	dB	Input Signal: 0 dBm0 @ 1.02 kHz
10		Envelope Delay	D_{AX}			270	µs	@ 1004 Hz
11		Envelope Delay Variation With Frequency — 1000-2600 Hz 600-3000 Hz 400-3200 Hz	D_{DX}		60 150 250		µs µs µs	Input Signal: 400-3200 Hz Sinewave at 0 dBm0
12	A N A L O G	Intermodulation Distortion — CCITT G712 50/60 Hz	IMD_{X1}			-55	dB	50/60 Hz @ -23 dBm0 and any signal within 300-3400 Hz at -9 dBm0
		CCITT G712 2 tone	IMD_{X2}			-41	dB	740 Hz and 1255 Hz @ -4 to -21 dBm0. Equal Input Levels
		AT&T	IMD_{X3}			-47	dB	2nd order products
		4 tone	IMD_{X4}			-49	dB	3rd order products
13		Gain Relative to Gain @ 1004 Hz (See Figure 10) — ≤50 Hz 60 Hz 200 Hz 300-3000 Hz 3200 Hz 3300 Hz 3400 Hz 4000 Hz ≥4600 Hz	G_{RX}	 -1.8 -0.125 -0.275 -0.350 -0.80 		-25 -30 0.00 0.125 0.125 0.030 -0.100 -14 -32	dB dB dB dB dB dB dB dB dB	0 dBm0 Input Signal Transmit Filter Response
14		Crosstalk D/A to A/D	CT_{RT}			-70	dB	0 dBm0 @ 1.02 kHz in D/A
15		Power Supply Rejection — V_{DD} V_{EE}	$PSSR_1$ $PSSR_2$	33 35			dB dB	Input 50 mV_{RMS} at 1.02 kHz
16		Overload Distortion (See Fig.15)						Input frequency=1.02kHz

* Typical figures are at 25°C with nominal ±5V supplies. For design aid only: not guaranteed and not subject to production testing.

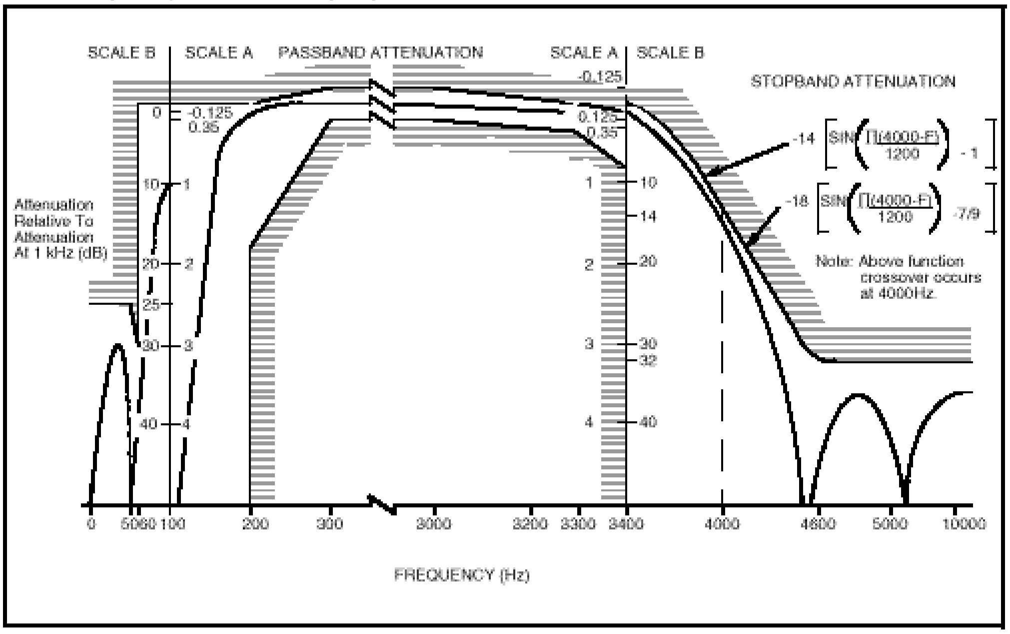
Note 6: 0dBm0=1.195 V_{RMS} for the µ-Law codec.
0dBm0=1.231 V_{RMS} for the A-Law codec.

AC Electrical Characteristics - Receive (D/A) Path - Voltages are with respect to GNDD unless otherwise stated.
T_A=0 to 70°C, V_{DD}=5V±5%, V_{EE}=-5V±5%, V_{Ref}=2.5V±0.5%, GNDA=GNDD=0V, Clock Frequency = 2.048MHz,
Filter Gain Setting = 0dB. Outputs unloaded unless otherwise specified.

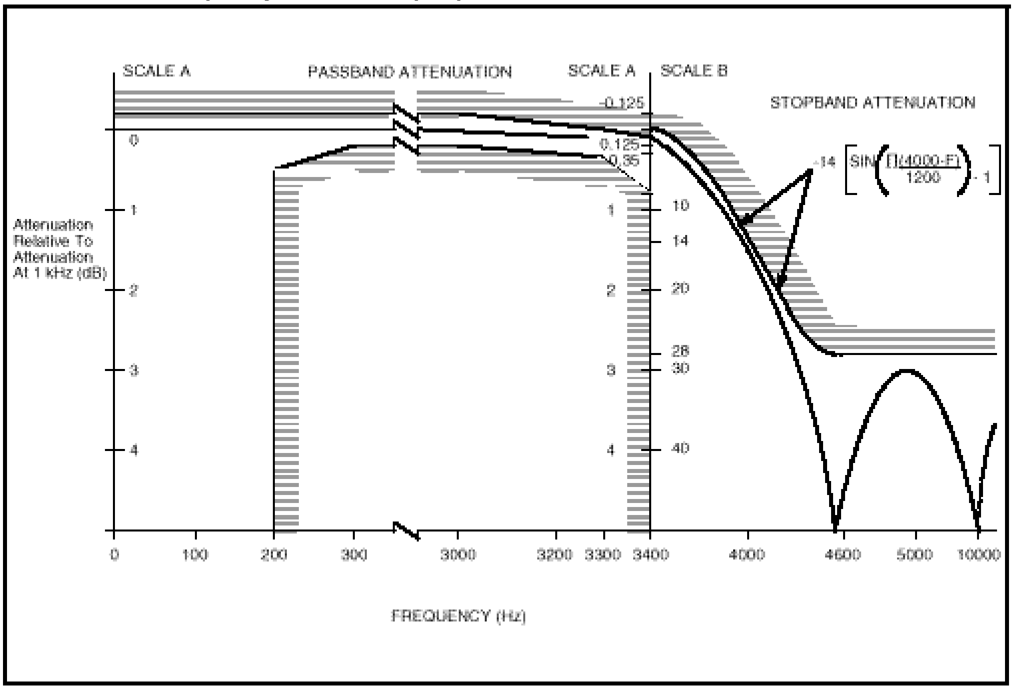
		Characteristics		Sym	Min	Typ*	Max	Units	Test Conditions
1	ANALOG	Analog output at V_R equivalent to the overload decision level at codec		V_{OUT}		4.829 5.000		V_{PP} V_{PP}	Level at codec: µ-Law: 3.17 dBm0 A-Law: 3.14 dBm0 R_L=10 KΩ See Note 7
2		Absolute Gain (0dB setting)		G_{AR}	-0.25		+0.25	dB	0 dBm0 @ 1004Hz
3		Absolute Attenuation (-1dB to -7dB settings)			-0.35		+0.35	dB	From nominal, @ 1004Hz
4		Gain Variation	With Temp.	G_{ART}		0.01		dB	T_A=0°C to 70°C
			With Supplies	G_{ARS}		0.04		dB/V	
5		Gain Tracking (See Figure 12)	CCITT G712 (Method 1)	GT_{R1}	-0.25 -0.25 -0.50		+0.25 +0.25 +0.50	dB dB dB	Sinusoidal Level: +3 to -10 dBm0 Noise Signal Level: -10 to -55 dBm0 -55 to -60 dBm0
			CCITT G712 (Method 2) AT & T	GT_{R2}	-0.25 -0.50 -1.50		+0.25 +0.50 +1.50	dB dB dB	Sinusoidal Level: +3 to -40 dBm0 -40 to -50 dBm0 -50 to -55 dBm0
6		Quantization Distortion (See Fig. 13)	CCITT G712 (Method 1)	D_{QR1}	28.00 35.60 33.90 29.30 14.30			dB dB dB dB dB	Noise Signal Level: -3 dBm0 -6 to -27 dBm0 -34 dBm0 -40 dBm0 -55 dBm0
			CCITT G712 (Method 2) AT & T	D_{QR2}	36.40 30.40 25.40			dB dB dB	Sinusoidal Input Level: 0 to -30 dBm0 -40 dBm0 -45 dBm0
7		Idle Channel	C-message	N_{CR}			12	dBmC0	µ-Law Only
		Noise	Psophometric	N_{PR}			-75	dBm0p	CCITT G712
8		Single Frequency Noise		N_{SFR}			-56	dBm0	CCITT G712
9		Harmonic Distortion (2nd or 3rd Harmonic)					-46	dB	Input Signal 0 dBm0 at 1.02 kHz
10		Intermodulation Distortion	CCITT G712 2 tone	IMD_{R2}			-41	dB	
			AT & T	IMD_{R3}			-47	dB	2nd order products
			4 tone	IMD_{R4}			-49	dB	3rd order products
11	ANALOG	Envelope Delay		D_{AR}			210	µs	@ 1004 Hz
12		Envelope Delay Variation with Frequency	1000-2600 Hz 600-3000 Hz 400-3200 Hz	D_{DR}		90 170 265		µs µs µs	Input Signal: 400 - 3200 Hz digital sinewave at 0 dBm0
13		Gain Relative to Gain @ 1004 Hz (See Figure 11)	<200 Hz 200 Hz 300-3000 Hz 3300 Hz 3400 Hz 4000 Hz ≥4600 Hz	G_{RR}	 -0.5 -0.125 -0.350 -0.80		0.125 0.125 0.125 0.030 -0.100 -14.0 -28.0	dB dB dB dB dB dB dB	0 dBm0 Input Signal Receive Filter Response
14		Crosstalk A/D to D/A		CT_{TR}			-70	dB	0 dBm0 @ 1.02 kHz in A/D
15		Power Supply Rejection	V_{DD} V_{EE}	$PSRR_3$ $PSRR_4$	33 35			dB dB	Input 50 mV_{RMS} at 1.02 kHz
16		Overload Distortion (See Fig. 15)							Input frequency=1.02 kHz

* Typical figures are at 25°C with nominal ±5V supplies. For design aid only: not guaranteed and not subject to production testing.
Note 7: 0dBm0=1.185 V_{RMS} for µ-Law codec and 0dBm0=1.231 V_{RMS} for A-Law codec.

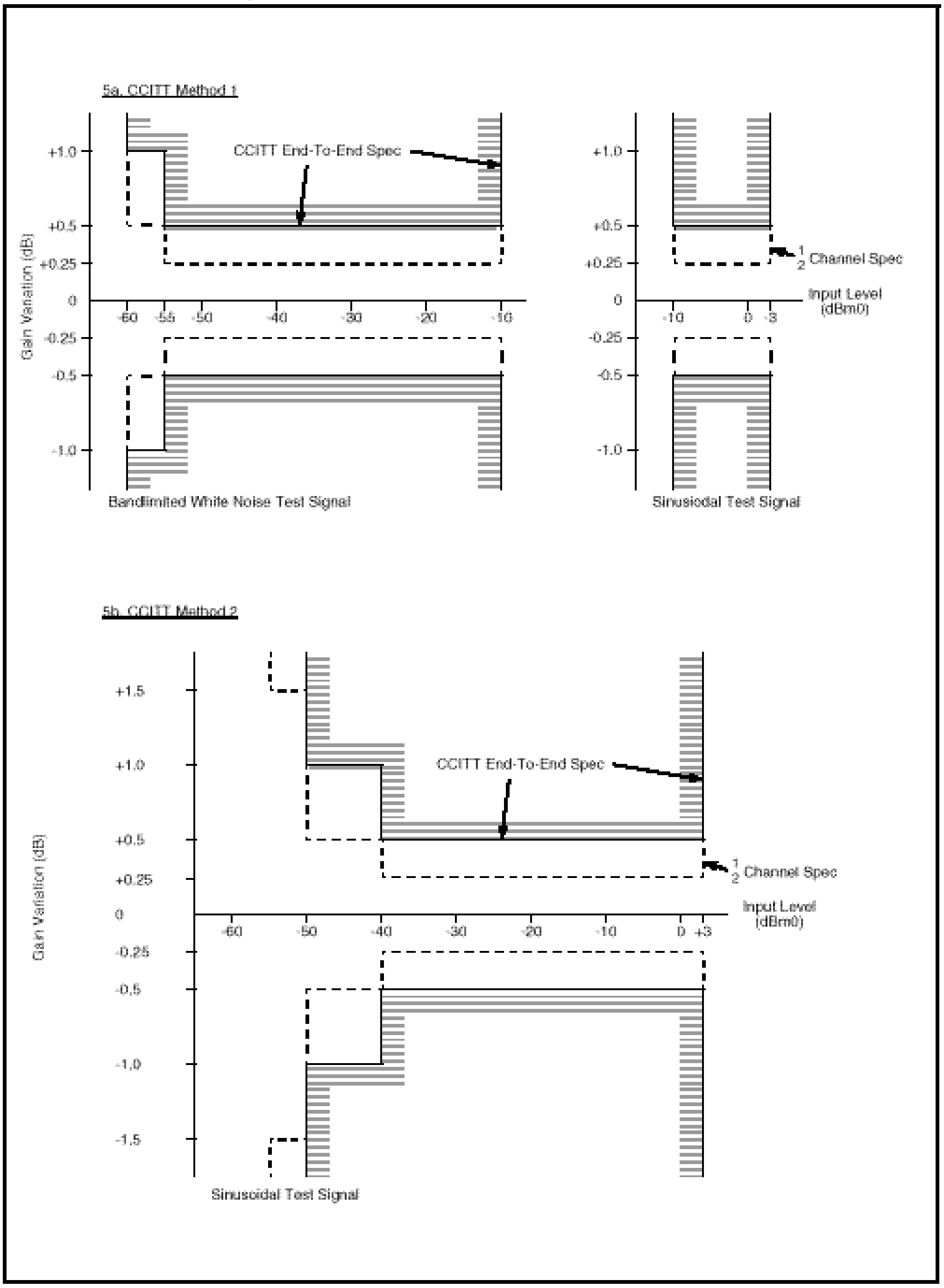
Attenuation vs Frequency for Transmit (A/D) Filter:



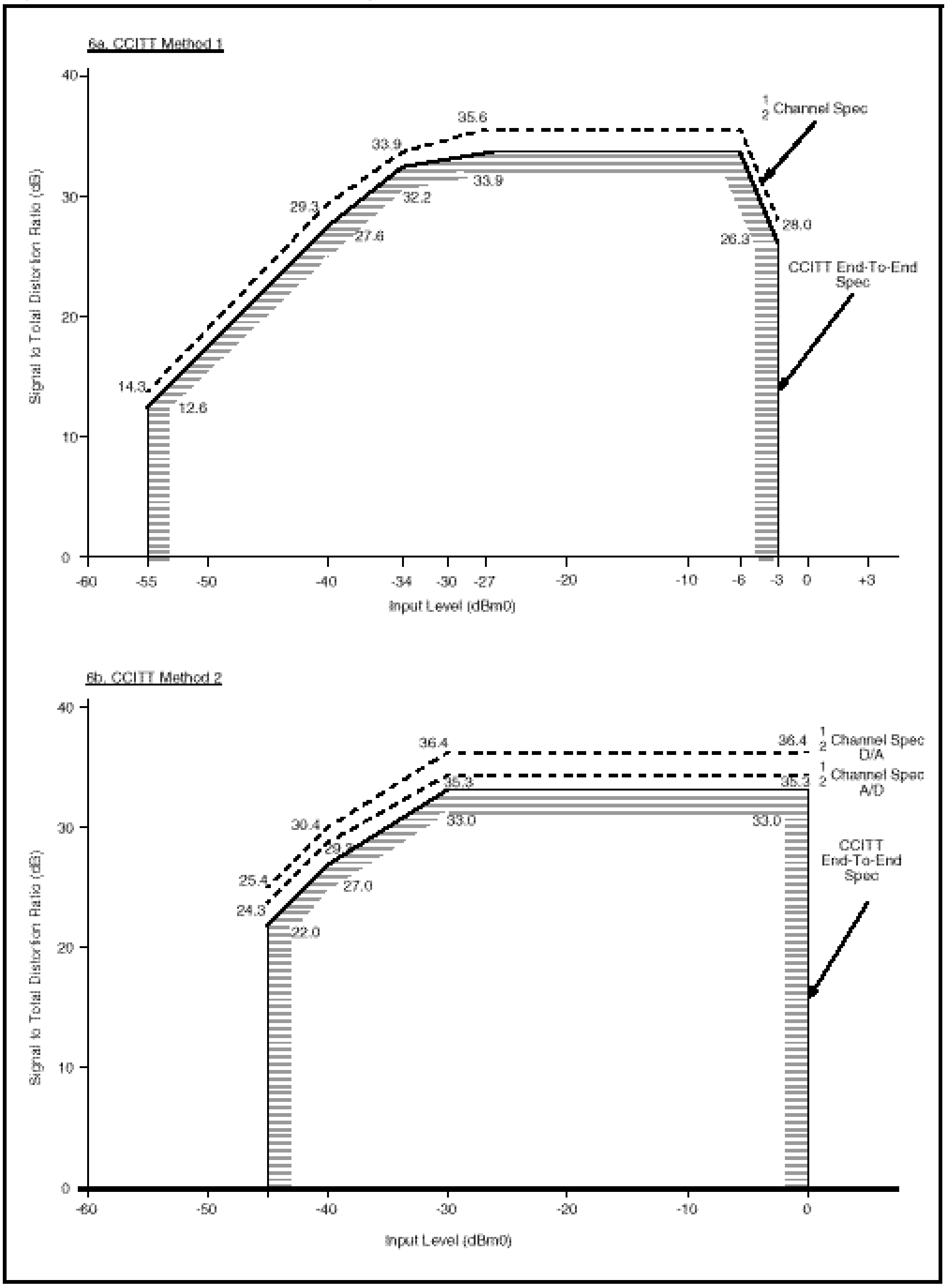
Attenuation vs Frequency for Receive (D/A) Filter



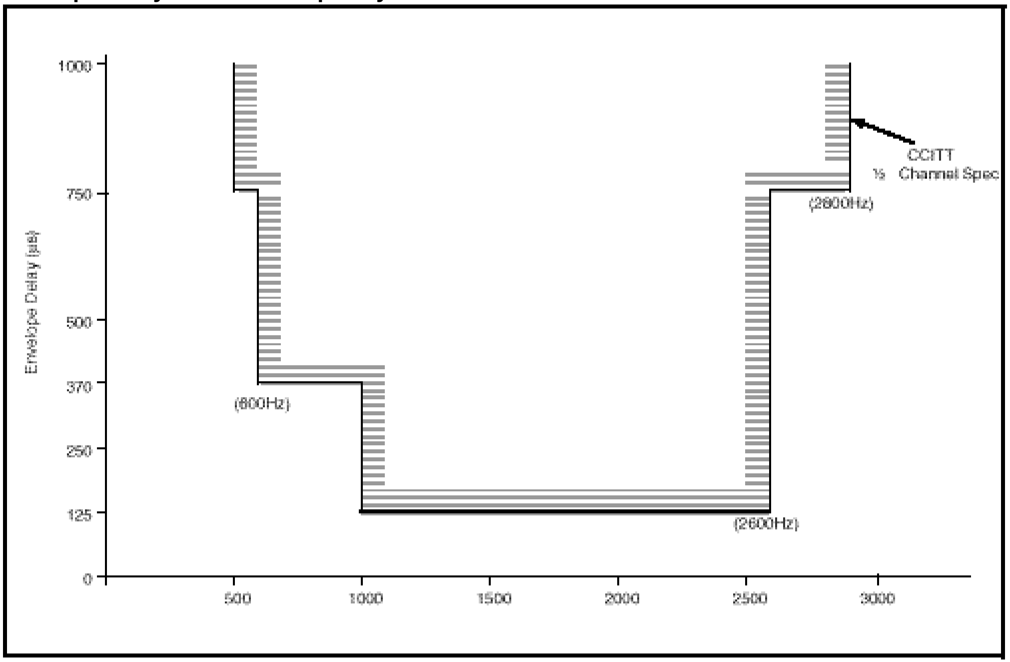
Variation of Gain With Input Level



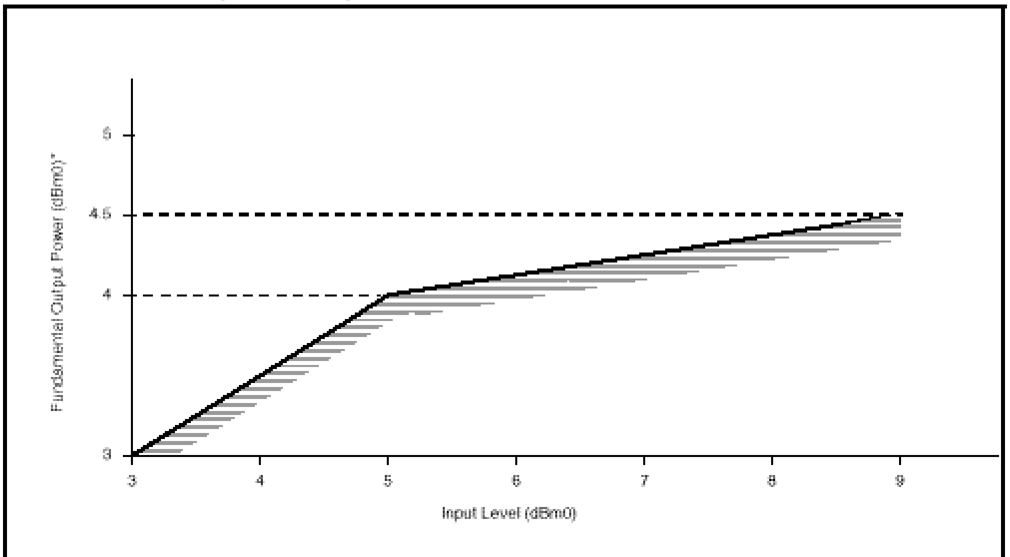
Signal to Total Distortion Ratio vs Input Level



Envelope Delay Variation Frequency



Overload Distortion (End-to-End)



*Relative to Fundamental Output power level with +3dBm0 input signal level at a frequency of 1.02kHz.

3. TRANSDATA PORT

To make high-precision analog measurements, the digital interface (TRANSDATA) can be used to connect an high-precision external CODEC. Functional characteristics are based on ITU X24, electrical characteristics are defined by ITU V11 and mechanical characteristics are defined by ISO 4903.

The pod is a DCE, it provides timing information: S clock for signal element timing and B clock for byte timing. It operates in "burst isochronous" operation with a nominal bit rate of 2048kbits/s: R/T transitions occur on OFF/ON transition of the S clock, R/T are sampled on ON/OFF transition of S.

In normal "simulation mode" R is an output and T an input, in "analysis only mode" R and T are outputs. The S clock is held in the ON condition during idle time.

4. CONCLUSION

The solution chosen to make analog I/O measurement with CLARINET depends on the precision required. The highest accuracy will be achieved when using an external high-precision CODEC.