This document presents a comparison of TDAS PRO specifications to the applicable performance requirements contained in sections 4, 8, and 10 of SAE J211, April 2004.

## 4. Data Channel Performance Requirements
It is important to note that SAE J211 covers the entire data channel, not just the data acquisition system. SAE J211 defines the "Data Channel" as follows:

> "All of the instrumentation from and including a single transducer (or multiple transducers whose outputs are combined in some specified way) up to and including any analysis procedures that may alter the frequency content or the amplitude content or the timing of data. It also includes all cabling and inter-connections."

The following table contains information that pertains to TDAS PRO conformance with SAE J211 requirements and does not include information regarding the performance of sensors, cabling and non-DTS post-processing software. Please contact sensor manufacturers and software vendors for additional information to evaluate complete data channel performance.
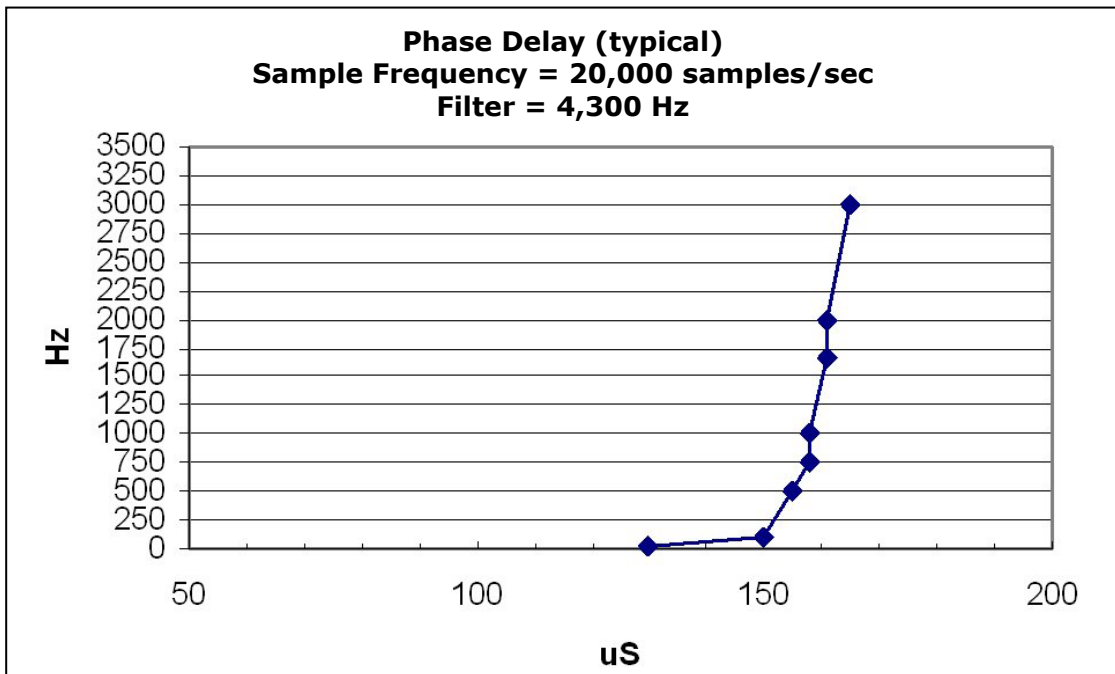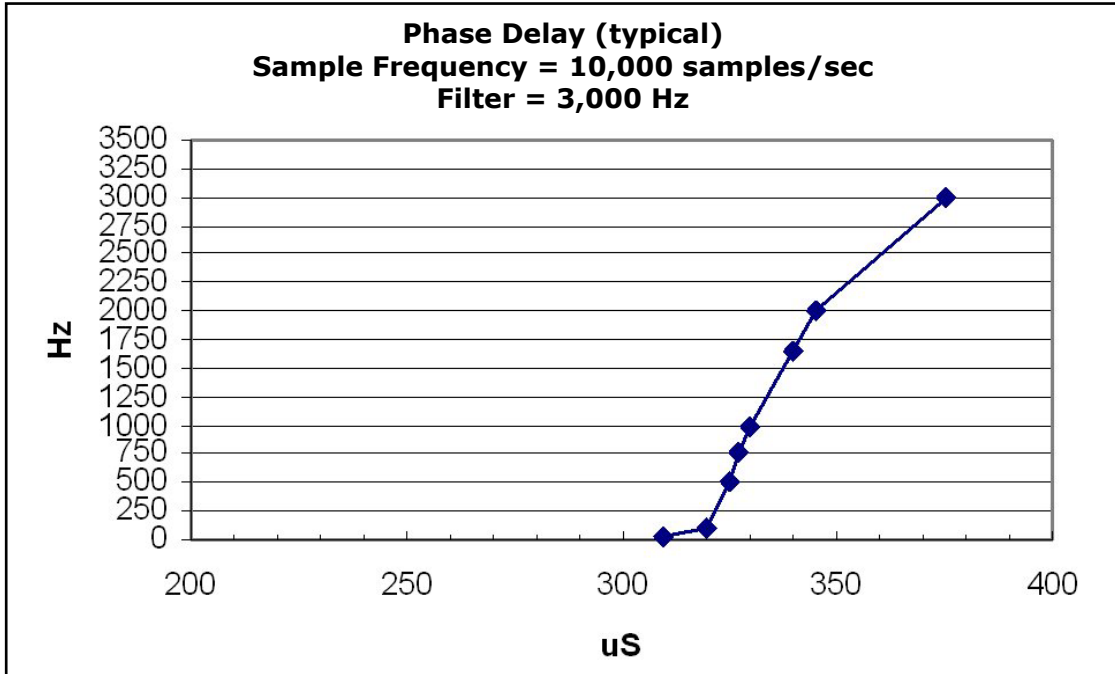
| Description	SAE J211 Requirement	TDAS PRO Specification
4.1) Linearity Error	$\leq$2.5% of full scale measured between F_L - F_H Hz (including instrumentation).	<0.2%. Comprehensively tested during calibration.
4.2) Amplitude Against Frequency	Figure 1 for CFC 1000 and CFC 600; Figure 2 for CFC 180 and CFC 60.	Every channel tested during calibration. See sample calibration graphs below.
4.3) Phase Delay Time	Shall not vary by more than 100 uS from 30 to 1,000 Hz	<50 uS. See graph below.
4.4.1) Time Base	At least 1/100 second resolution. Error <0.1 ms.	<0.1 ms resolution. <0.1 ms error.
4.4.2) Relative Time Delay	<1.0 msec between all channels and <0.1 msec between channels used together in a calculation.	<0.1 msec between all channels.
4.6.1) General	Calibration against reference equipment shall not introduce an error >1%.	Calibration equipment shall be better than 0.1%.
4.6.4) Calibration of Frequency Response	Determined by measuring output signals with a known input signal from DC to 3 KHz.	Response shall be measured from DC to 10 KHz.

4.2) Amplitude Against Frequency

Sample Calibration Plot
Hardware and Software Filter Response
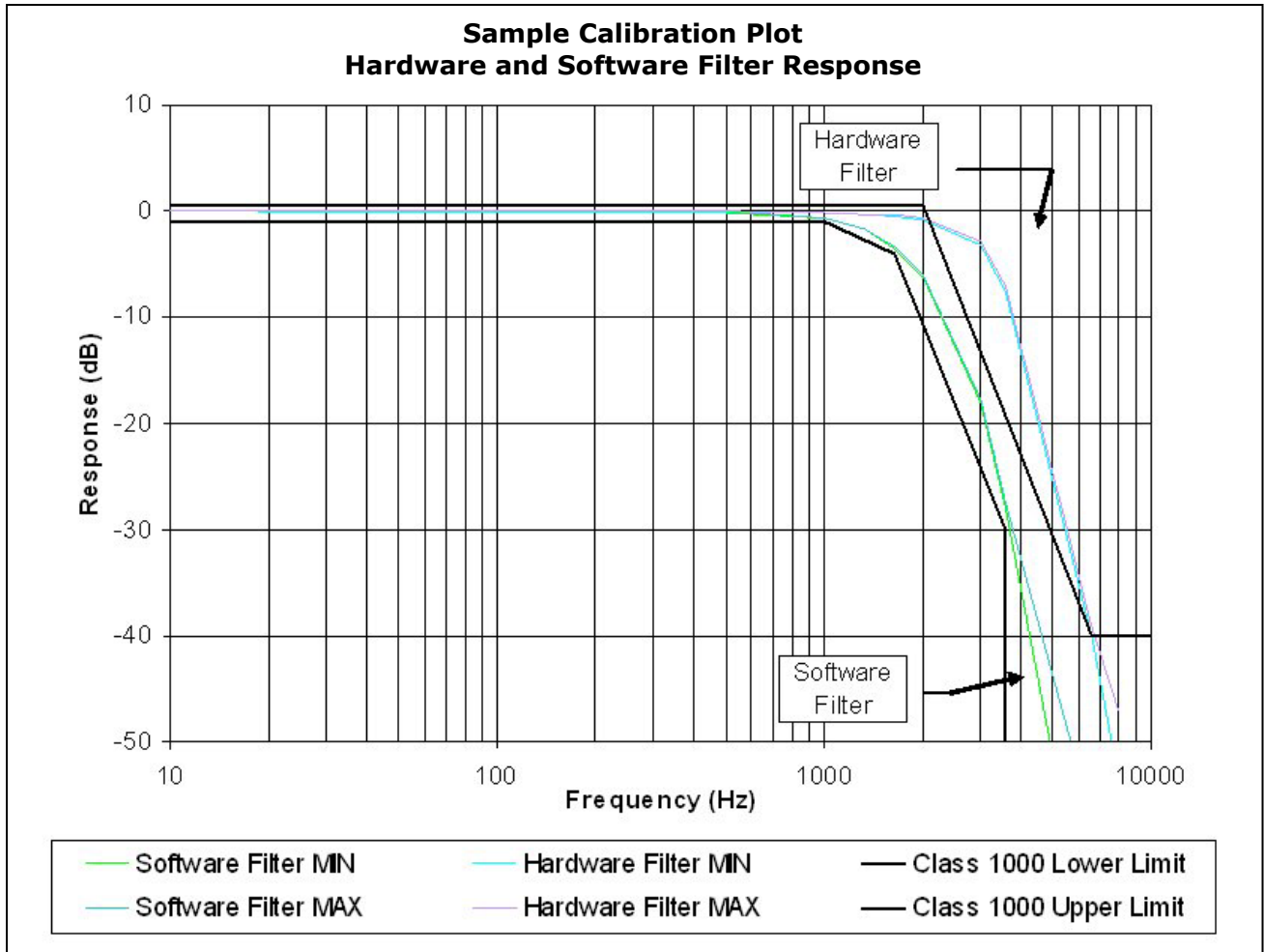
4.3) Phase Delay Time

SAE J211 requires <100 uS variance from 30 to 1,000 Hz. TDAS PRO is typically ≤30 uS.

Phase Delay (typical)
Sample Frequency = 10,000 samples/sec
Filter = 3,000 Hz

Phase Delay (typical)
Sample Frequency = 20,000 samples/sec
Filter = 4,300 Hz

8. Digital Data Processing

Description	SAE J211 Requirement	TDAS PRO Specification
8.1) Presample Filtering	At or above CFC 1000.	Responses can meet CFC 1000 corridor with hardware or software filters.
8.2) Sampling Rate	10K samples/sec/channel.	10-38K samples/sec/channel. (All channels sampled.)
8.3) Resolution	12-bit minimum and least significant bit <0.2% of full scale.	16-bit.
8.4.1) Digital Filtering	CFC filtering must meet corridors in section 4.	4-pole phaseless Butterworth filter algorithm as supplied by NHTSA.
8.4.2 and 8.4.3) Scaling and Zeroing	Software used to determine zero levels and scale factors.	Gain measured each time the system is used. Many software zeroing options.
10) Time of Contact	Determined within ±0.5 msec.	-0.1 ms to +0.2 ms. See graph below.
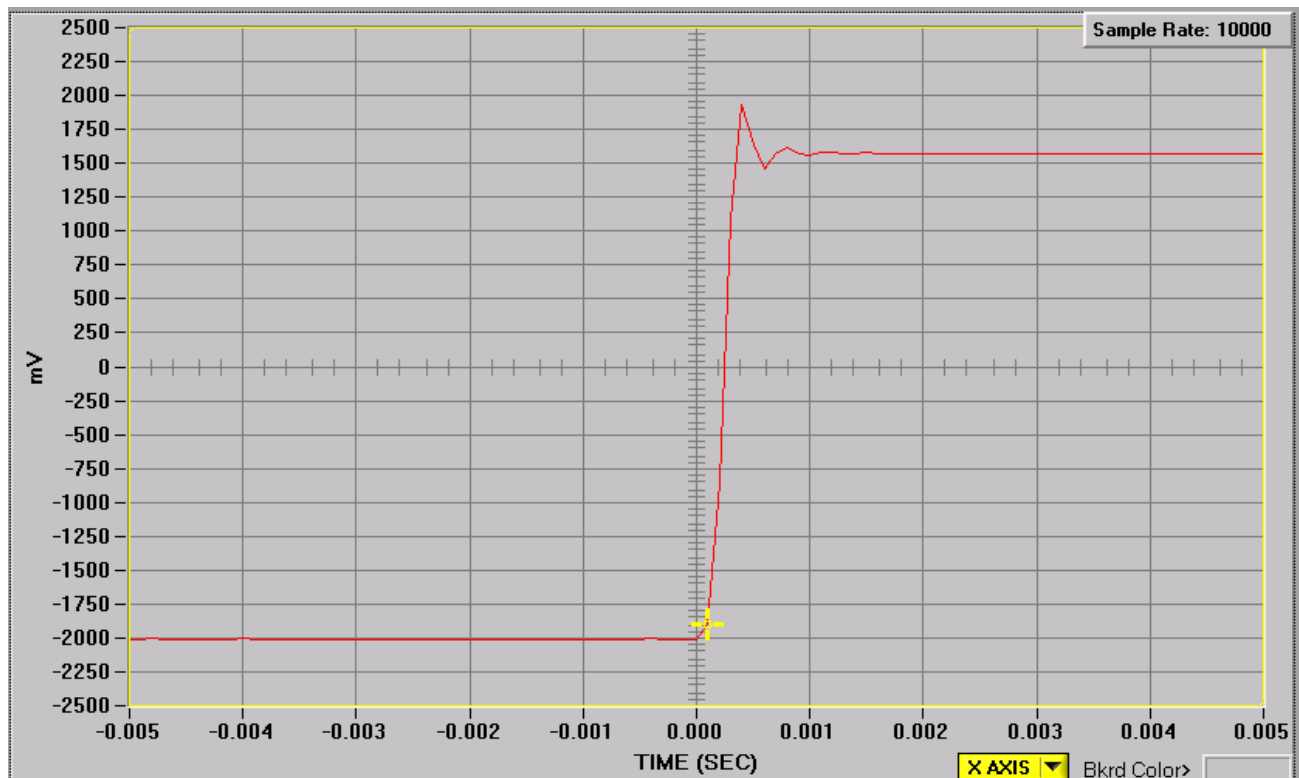
Step wave connected to event input and data channel.

Additional Performance Information

DTS uses a 100 Hz square wave signal to check for amplitude accuracy and overshoot.

- 100 Hz square wave signal calibrated to ±1000 mV
- Recorded at 10,000 samples per second with anti-alias filter applied
- No software filtering

Requirements:
Amplitude accuracy meets DTS specification
Overshoot less than 13% (typical 10%)