

Integrated Combustion Analysis System (iCAS)

iCAS comprises an add-in component to the CADET V12 software and additional data acquisition hardware.

The data acquisition hardware comprises one or more DTC-VAD-02 Analogue to Digital interface cards. Each card has one +/-10v differential input channel with a conversion resolution of 16-bits and a maximum sample rate of 100KHz.

Each rack can accommodate a maximum of 10 cards (channels) up to a maximum total of 32 channels spread across four racks.

The system supports external (shaft encoder mode) or internal (timed mode) clock synchronisation of the channels. When using external synchronisation, all channels within a rack can be driven from a single CLOCK and SYNC (TDC) input and up to four racks daisy chained externally. If internal synchronisation is used then up to two racks (i.e. a maximum of 20 channels) can be synchronised.

Each input channel has a 256Kbyte memory buffer which can operate in rolling or fixed mode and is capable of storing up to 131072 16-bit samples.

The CADET V12 system interfaces to the data acquisition hardware using a PCI parallel interface card that is capable of downloading up to 64000 Samples per second.

CP Engineering is developing a faster USB 2.0 based interface that will be capable of downloading up to 2,000,000 Samples per second from the existing rack architecture. Use of the new USB interface will only require replacement of the DL-INT-02 interface card in each rack and a computer system supporting USB 2.0 running Windows 2000 or XP.

Data acquisition software

The data acquisition software comprises an add-in component for the CADET V12 system, user configurable calculations, configuration editor and extensions to the trace viewer.

During operation the CADET V12 system displays graphic and numeric combustion data.

An additional user project (CAS Special Functions) integrates with the existing CADET V12 Visual Basic user customisation features to allow per firing cycle and other calculations. A suite of standard calculations is provided.

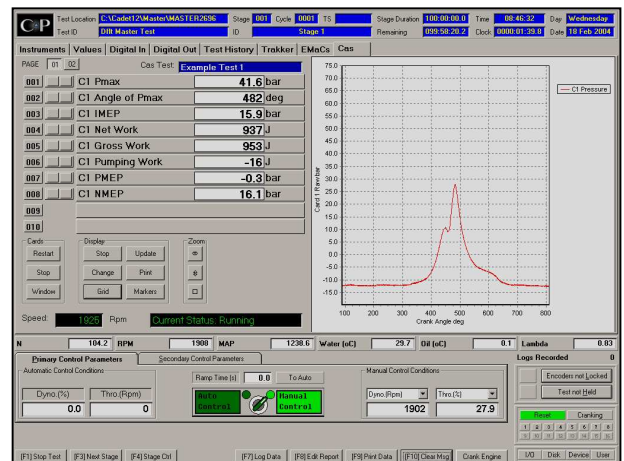
A standalone editor allows configuration of the data acquisition hardware and software operation.

Measurement capability

The system provides two basic modes of operation

- Capture and download of continuous and contiguous windowed cycle data for successive firing cycles
- Capture and download of contiguous whole cycle data for a specific number of successive firing cycles.

The first mode (a) of operation is limited by the overall download capability of the existing parallel interface. A windowing feature is used to capture part of the firing cycle (by specifying start & end shaft angle) to minimise the amount of data downloaded. The window is defined using User Variables and is thus suitable for use with sweeping scenarios where the area of interest may change during the progress of a test. This mode therefore allows continuous and contiguous calculation of knock as required for the iCAM system.



CP Data Sheet

The following table illustrates some examples of the performance for cylinder pressure that can be expected using external shaft encoder mode for two and four-stroke engines. This will allow continuous and contiguous knock calculation at the specified engine speeds.

Cylinders #	Firing cycle window of interest Degrees	Shaft encoder resolution Degrees	Download Data rate Samples per second	Engine Speed RPM
1	720°	1°	63600	10600
1	720°	½°	63600	5300
1	450°	1°	63750	8500
1	225°	½°	63750	8500
2	225°	1°	63750	8500
2	112°	½°	63750	8500
4	128°	1°	64000	7500
4	64°	½°	64000	7500
8	64°	1°	64000	7500
8	32°	½°	64000	7500

USB system

The USB 2.0 interface will provide much higher data download rates enabling continuous and contiguous measurement of complete firing cycles. As a typical example the existing rack architecture will enable **each** rack to support 5 channels @ 8300rpm with ½° resolution and 10 channels at 1° resolution.

Due to much higher data rates it is likely that a higher specification PC will be required to operate the configuration and perform firing cycle calculations.

The second mode (b) of operation is limited only by the sampling rate and memory buffer of the data acquisition cards. In this mode the system is operated with a fixed memory buffer capturing successive firing cycles at clock rates up to the maximum sampling rate of the DTC VAD-02. When the memory buffer is full it is downloaded and the entire process repeated.

The following table illustrates some examples of the maximum performance that can be expected using external shaft encoder mode for two and four-stroke engines.

Channels #	Firing cycle window of interest Degrees	Shaft encoder resolution Degrees	Maximum Engine RPM	Number of Samples Per channel	Number of Contiguous firing cycles
Up to 32	720° (4-stroke)	1°	16600	131040	182
Up to 32	720° (4-stroke)	½°	8300	131040	91
Up to 32	360° (2-stroke)	1°	16600	131040	364
Up to 32	360° (2-stroke)	½°	8300	131040	182

The maximum download time for 10 channels is approximately 20 seconds.