COMBUSTION ANALYSIS SYSTEM

DS-3000 *Series*

High-speed processing for the next level of combustion analysis!

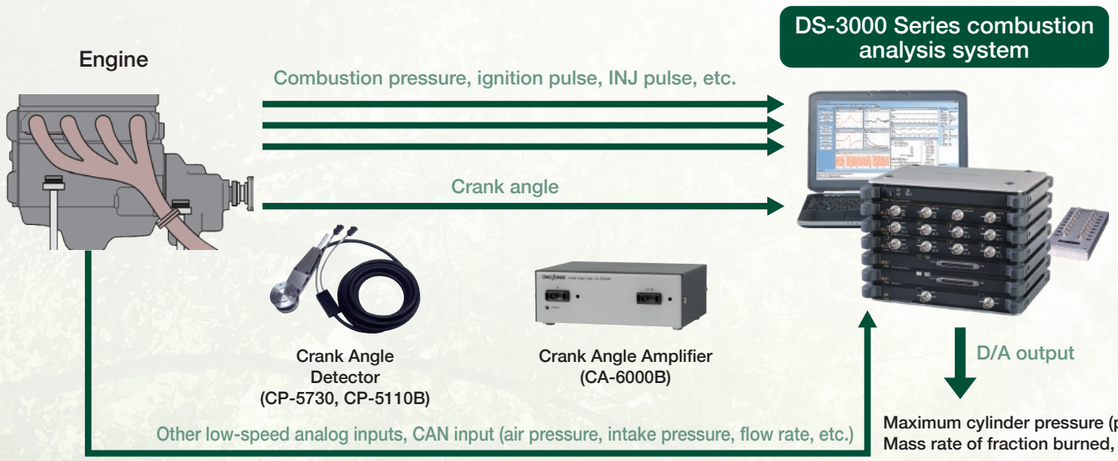
ONO SOKKI

The ultimate combustion analyzer for research and development on increasing fuel efficiency and downsizing engines.

With the ongoing research and development for improving combustion technologies (HCCI, EGR, etc.), new power sources (HEV and PHEV) and new fuels (biodiesel and natural gas) and the quest to increase fuel efficiency with a smaller engine, combustion analyzers are in greater demand than ever.
Succeeding the DS-2000 Series combustion analysis system, which have the largest market share in Japan, the DS-3000 Series combustion analysis system meets growing expectations with its new, more powerful hardware.

Features

- Supports multiple types of fuels (Liquid fuel, gaseous fuel)
- Measurement and calculation in real time
- Trend display in real time
- Supports start / stop combustion testing
- Enables measurement without an encoder
- Linked with other companies' products



Hardware

DS-3284 4 ch Combustion Analysis Unit

AC adapter: 60 W type (100 to 240 VAC / 1.4 A) /
150 W type (100 to 240 VAC / 2.5 A) sold separately
DC power supply: 10.5 to 16.5 V
Power consumption: 27 to 67 W
Operating temperature range: 0 to +40 °C
(With no condensation)
CE marking: conformed
The number of maximum units: 9 units (DS-0380: up to 28 ch,
DS-0381 / 0382: up to 32 ch)
Weight: approx. 3.1 to 8.5 kg
Interface: USB 3.0 interface (USB 2.0 also can be used, however data transmission speed is slower than using USB 3.0)
Note: 150W type AC adapter is required in 5 or more units.
(Cooling fan is attached.)

Assemble example:
8 ch high-speed A/D input + 16 ch low-speed A/D input
+ 16 ch D/A output + 2 ch sound & vibration input

1 DS-3280 Combustion Analysis Main Unit

2 DS-0378 Combustion Analysis Pulse Input Unit

■ 1 P/R input, angle pulse input

Input method: single-ended
Input impedance: 100 kΩ
Coupling: AC or DC coupling
Voltage range: ±10 V
Absolute maximum input voltage: ±45 V
Minimum input voltage: 1.0 Vp-p
1 P/R input: 0.5 / 1 P/R
Angle pulse input: 180 / 360 / 720 / 1800 / 3600 P/R

■ Isolation

Isolated between “1 P/R input, angle pulse input”, “External start input” and “Status output”（Common of 1 P/R input and angle pulse input is shared.）

■ External start input

Input format: TTL or non-voltage contact signal
Internal pull-up resistor: 100 kΩ connected to internal +5 V
Minimum pulse width: 10 ms

■ Status output

Output format: TTL

3 DS-0380 4 ch Combustion Analysis High-speed A/D Unit

The number of input channels: 4 ch / unit (Max. 28 ch)
Input method: single-ended
Isolation: isolated between units
（COM signal of 4 inputs in an unit is shared.）
Input impedance: 1 MΩ
Coupling: DC coupling
Voltage range: ±0.1 / 0.2 / 0.5 / 1.0 / 2.0 / 5.0 / 10.0 V
Absolute maximum input voltage: ±50 V
Offset voltage: ±100 % voltage range F.S.
（Error: ±1.0 % or less）
A/D resolution: 16-bit sequential transformation type
Sampling frequency: max. 1 MHz

4 DS-0381 16 ch Combustion Analysis Low-speed A/D Unit

The number of input channels: 16 ch / unit (Max. 32 ch)
Input method: single-ended
Isolation: non-isolated
Input impedance: 1 MΩ
Coupling: DC coupling
Voltage range: ±1.0 / 2.0 / 5.0 / 10.0 V
Offset errors: ±0.1 % F.S. or less
A/D resolution: 16-bit multiplex method
Sampling angle: 45°

5 DS-0382 16 ch Combustion Analysis A/D Unit

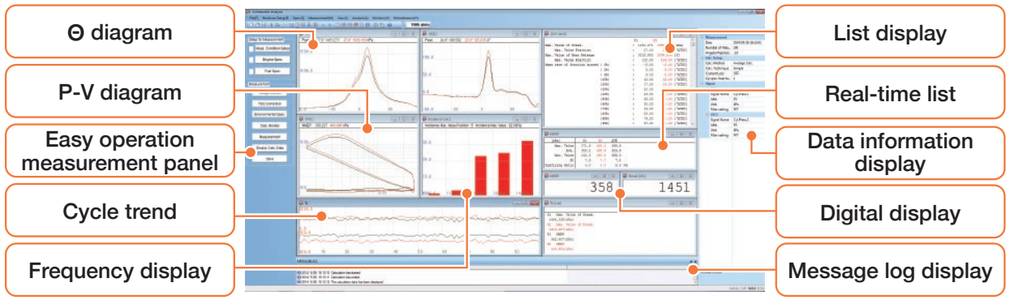
The number of output channels: 16 ch / unit (Max. 32 ch)
Output method: single-ended (Common of each channel is shared.)
Isolation: non-isolated
Output impedance: 1 Ω or less
Load impedance: 10 kΩ or more
Voltage range: ±10 V
Maximum output current: ±1 mA
D/A resolution 14-bit
Settling time: 100 µs or less (From -10 V to +10 V)
Coupling: DC coupling

6 DS-0366 2 ch 100 kHz Range Input Unit

The number of input channels: 2 ch
Input method: single-ended
Isolation: isolated between each channels
Input impedance: 1 MΩ
Coupling: DC or AC coupling
Voltage range: -40 to 20 dBVrms
10 dB step, 7 range
Residual offset: -60 dB F.S. or less (0 to 20 dBVrms range)
-45 dB F.S. or less (-40 to -10 dBVrms range)
A/D resolution: 16 bit
Sampling frequency: max. 100 kHz
Power supply current for sensor: 24 V/ 4 mA

DS-0328 Combustion Analysis Software

Basic software of combustion analysis including monitor, measurement, calculation, and data storage functions.



- The number of input pulses: 180 / 360 / 720 / 1800 / 3600 P/R
- Angular sampling resolution: 0.05 / 0.1 / 0.25 / 0.5 / 1.0°
- Input rotation range: 0.05°:10 to 8,000 r/min
  0.1°:10 to 16,000 r/min
  0.25 / 0.5 / 1.0°:10 to 25,000 r/min
- Test mode: Manual, auto storage, starting test
- Setup specification (Environmental, engine, and fuel specifications)
  ・Specific heat ratio calculations are possible, based on the entered fuel composition corresponding to thermodynamic calculation of liquid and gaseous fuel.
  Liquid fuel: Setting of composition weight ratio for C, H, H_2O, O, S
  Gaseous fuel: Setting of element ratio for C, H, O
  ・EGR ratio, i.e. re-circulated gas weight, is calculated.
- Voltage monitor function
- 1 P/R and ANGLE pulse monitor function
- All cylinder TDC auto correction function
  ・Corrections based by motoring and gap sensor
- Drift correction / physical quantity setting function
- Analysis function
  List view, Crank angle diagram, Cycle trend diagram, Filter process (Moving average, FFT filter), Calculation method (Precise, Simple, K constant), Coolant loss ON / OFF, Selecting the correction expression and changing of heat transfer coefficient, Measurement of low-speed A/D, high-speed A/D environmental specification value
- Calculation functions
  Crank angle diagram:
  Stroke volume, Internal cylinder pressure, Internal cylinder pressure increase rate, Heat release rate, Heat release quantity, Mass rate of fraction burned, Combustion gas temperature, Injection pressure, Fuel injection quantity, Fuel injection rate, Needle valve lift amount, Arbitrary specified physical quantity, Gas weight, Gas constant, etc.

  List display, trend display:
  Engine speed, Maximum value and position of cylinder pressure, Heat release quantity, Position of mass rate of fraction burned (every 10%), Combustion efficiency, Combustion start / end position, Center of gravity value and position of heat release rate, Maximum value and position of combustion chamber gas temperature, Constant volume ratio, IMEP, NMEP, COV, Weibe function value, Fuel injection start / end position, Center of gravity value and position for injection rate, Others: P-V, Log (P-V)

- Overlaying / Multiple cycle window
  With this application software, it is possible to overlay a selected set of data, one over the other. It is also possible to overlay the results of the current calculation over the calculation results of another CBD/CBDR file, and to overlay multiple cycle data one upon the other on the calculation results screen.
- Calculation results, both real-time and intermittent, shown on the same trend window
  Real-time and intermittent calculation results can be paired as desired and shown in up to ten windows. Up to 20 functions can be shown in one window.
- Calculated waveform window data export
  Θ diagrams and trend windows data shown on the screen can be exported as CSV files or in Metafile format.
- Others
  Auto storage measurement, Simple operation measurement, External start input, Calculation cursor, Averaging process of calculation monitor, Setting for text file output format, Output of absolute angle text file, Continuous calculation / Environmental specification file reading function, Graph scale zooming function, 1 P/R and 1 P/2R measurement function

Low-speed A/D input function

By adding the DS-0381 16 ch Combustion Analysis Low-speed A/D Unit, environment specifications and other data can be measured. Measurements, made every 45°, are averaged out to obtain the representative cycle value.

Analog output function

By adding the DS-0382 16 ch Combustion Analysis A/D Unit, calculated combustion values can be sent out as voltage signals during calculation monitoring. The combustion parameters whose functions can be shown in calculation monitor are programmable.

■ Angular resolution and the maximum number of measurement cycles

Angular Resolution[°]	The number of maximum cycles	Recording time (1,800 r/min average)
0.05	2,000	Approx. 2 min
0.1	4,000	Approx. 5 min
0.25	10,000	Approx. 10 min
0.5	20,000	Approx. 20 min
1.0	20,000	Approx. 20 min

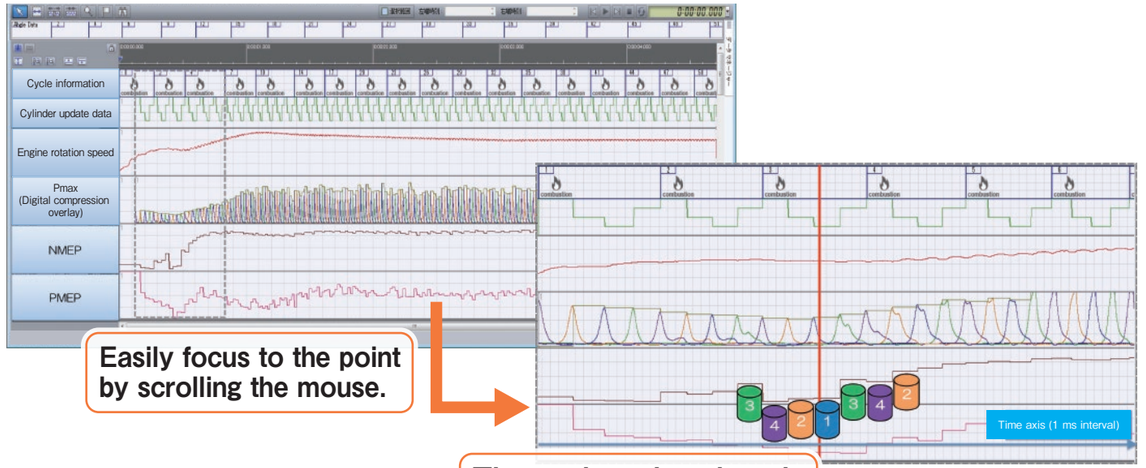
Digital output function

As the standard function of DS-0378 Combustion Analysis Pulse Input Unit the operating status of the combustion analysis system can be output as TTL signals. When building the measurement system using with start signal and timing signal with other measurement instruments, the sequence taking into account the operating condition of combustion analysis can be created.

Analyze smoothly on the time-axis using with the OS-2000

The TDMS file conforming to ASAM format can be output. The following data are stored in the TDMS file: actual measured angle axis data including internal cylinder pressure signal and TDC calculation data which is used to check the time difference of combustion calculation result (NMEP, combustion weight ratio position, etc.).

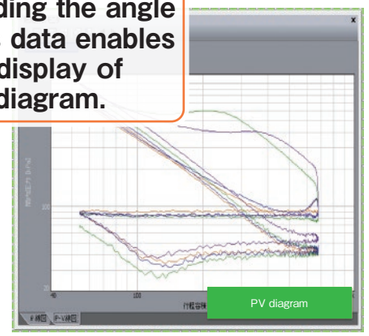
By importing the TDMS file to the OS-2000 series, the phenomenon of angle axis data is analyzed while checking the time axis difference of the combustion calculation result in OS-2000 series.
The OS-2000 can import the performance data file (.thd) measured by FAMS and ECU data (.mf4) measured by INCA made by ETAS corporation. With the OS-2000, the three data files (.thd file, .mf4 file, and TDMS file) can be synchronized on time-base, and compare and analylze the data.

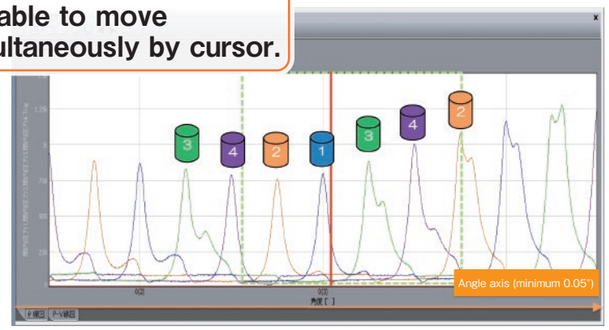


Easily focus to the point by scrolling the mouse.

Time axis and angle axis are able to move simultaneously by cursor.

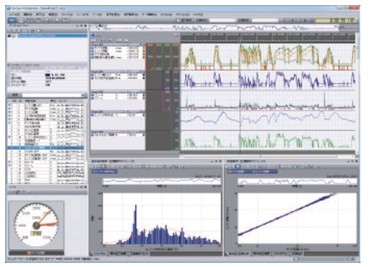
Holding the angle axis data enables the display of PV diagram.





OS-2000 series Time-series Data Analysis Software

The OS-2000 series allows you to edit and analyze long time-series data freely that is not able to be handled by Microsoft® Excel®.
This software can handle data formats of recorder made by other company as well as general-purpose formats including CSV and WAVE. The waveform of different sampling data are displayed simultaneously and overlapped. You can divide, move, zoom in and out waveform freely. There are various functions such as playback, FFT analysis and sound quality evaluation.

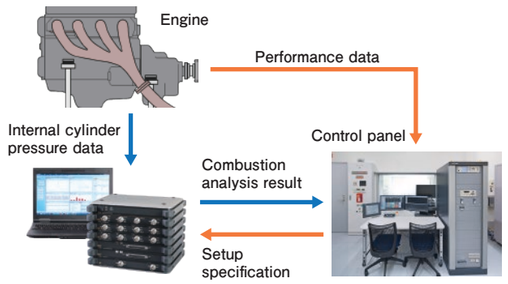


DS-0336 Combustion Data Link Function

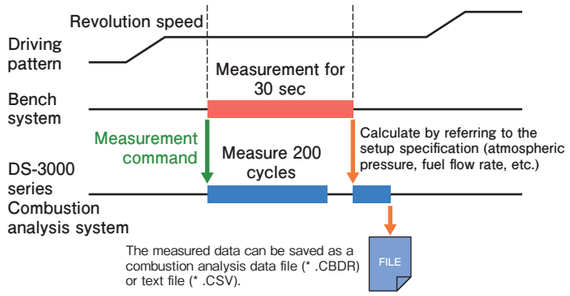
This function enables the link measurement between the DS-3000 series combustion analysis system and the customer's bench system.

- ●Data communication through TCP/IP sockets.
- ●Synchronized recording of performance data and combustion analysis data can be achieved by linking with bench system.
- ●The measured data can be saved as a combustion analysis data file (* .CBDR) or text file (* .CSV)
- ●The calculation can be performed by referring to the performance data (atmospheric pressure, fuel flow rate, etc.) measured on the bench test as the setup specification data for combustion analysis.

System configuration example

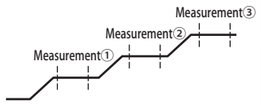


Sequence example

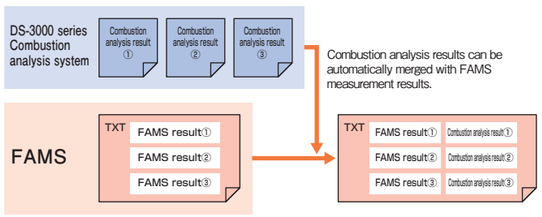


●FAMS-8000/FAMS-R5 Data merge function

The average of combustion analysis result saved every one-step measurement can be automatically merged with the general recording data of FAMS. After a series of step measurements are completed, you can obtain both the combustion analysis data and performance data at the same time. Thus, you can save time to arrange data in secondary processing.



When measurement is performed a few times, the combustion analysis result will be automatically saved every measurement.

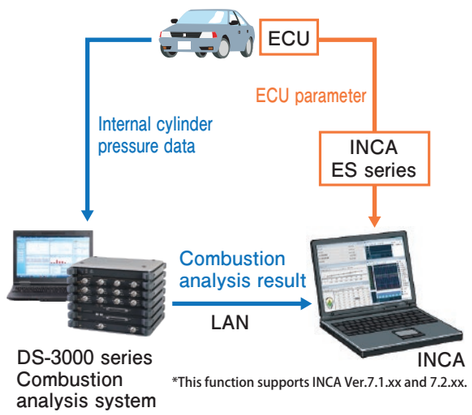


Combustion analysis results can be automatically merged with FAMS measurement results.

DS-0365 INCA Link Function

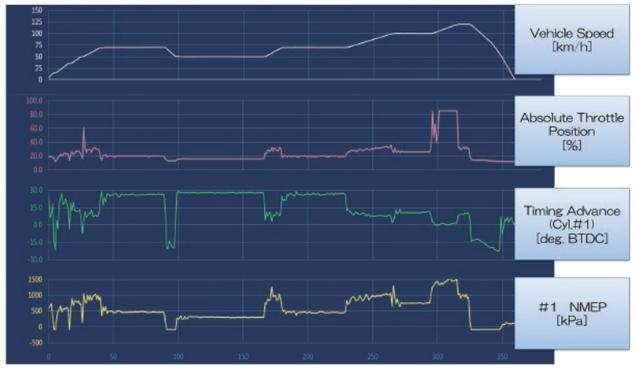
This function enables link measurement with ECU calibration tool, INCA made by ETAS. The difference at the start of measurement between the ECU performance data and the combustion analysis data is adjusted, and the data is transmitted by adding time information to the combustion analysis result for each cycle. Thus, the accuracy of synchronization can be maintained within one cycle.

System configuration example



*This function supports INCA Ver.7.1.xx and 7.2.xx.

INCA display image



DS-0335 SYNC Measurement Function

The engine start/stop test mode of the DS-2000 series/DS-3000 series combustion analysis system have supported the engine unit test of vehicles equipped with idling stop system and hybrid vehicles for many years. In recent years, the mode tests such as JC08 mode and NEDC mode have been performed on vehicles that are closer to finished vehicles to evaluate their performance. Selecting SYNC measurement mode enables users to utilize more the current engine start/stop measurement.
* DS-0329 Knocking analysis function cannot be used with this function at the same time.

■ Engine start/stop test mode

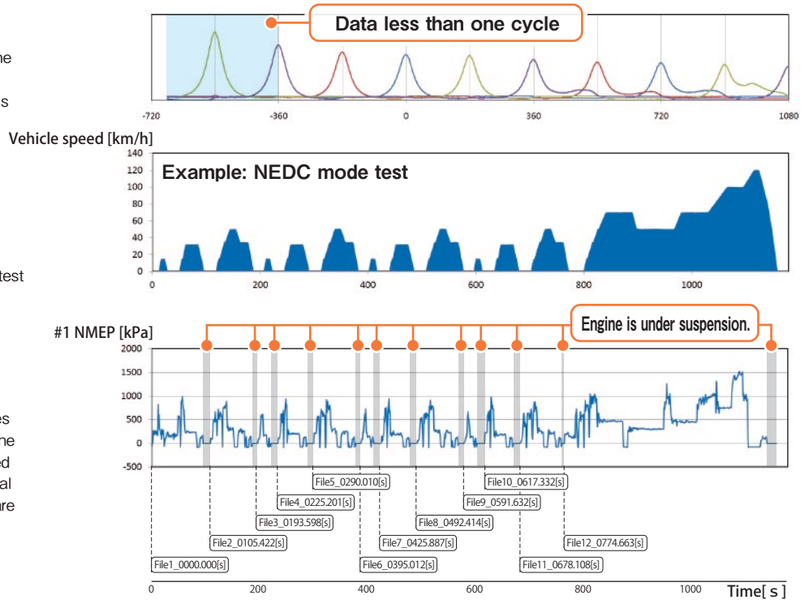
The measurement starts simultaneously with the initial movement of the crank axis. This is the standard function to monitor the ANGLE signals always and to perform automatic file storage immediately after stop of the crank axis.

■ SYNC measurement mode

In this mode, you can perform monitoring and analog output of the calculated results while starting measurement in the engine start/stop test mode.

■ Total time stamp

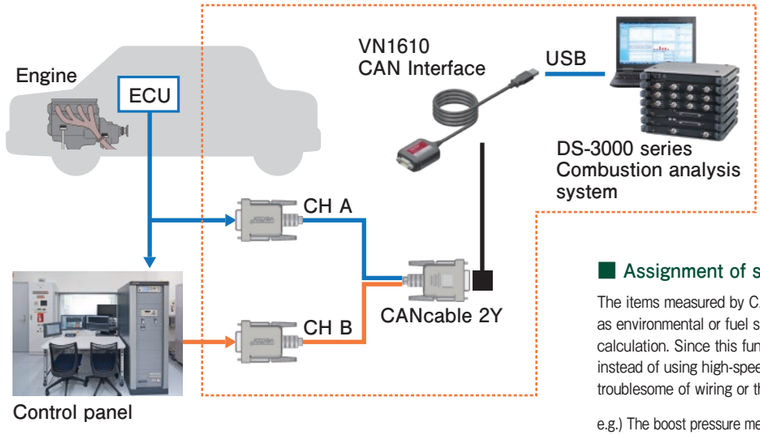
When the engine is repeatedly started and stopped in the mode test, the measurement files are output as shown in the right figure. Since the each file has total time stamp information based on the first file with 1 ms accuracy, the temporal continuity of files are maintained even if they are divided.



DS-0383 CAN Measurement Function

This function enables to measure by synchronizing the combustion analysis data with CAN data which is indispensable for automotive control. Since two channels are available, you can not only measure the RAM value in the vehicle, but also acquire information from the control system and other instruments using CAN communication. Vector's VN1610CAN interface is used as the CAN communication system (included in the options).

System configuration example



CAN Measurement detail

- ・Number of port: 2 ports
- ・Number of data acquisition: Max. 32 ch (sum of two ports)
- ・Baud rate: 33.333 kbps/50.0 kbps/100.0 kbps/ 125.0 kbps/250.0 kbps/500.0 kbps/ 1000.0 kbps
- ・Sample clock: 1000 Hz/500 Hz/200 Hz/100 Hz/10 Hz
- ・Standard ID (11 bit) , Enhanced ID (29 bit) are supported.
- ・Loading CANdb file (.dbc) is supported.

■ Assignment of specification data via CAN communication

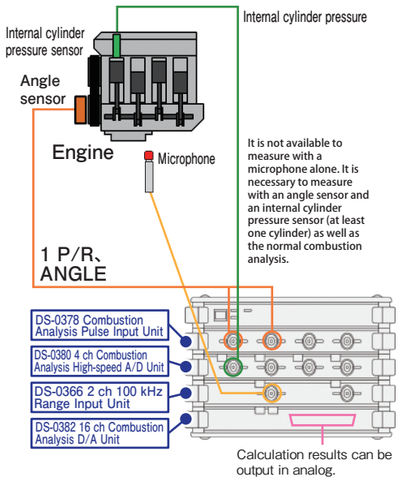
The items measured by CAN can be assigned to the combustion calculation data as environmental or fuel specifications that are required for the combustion calculation. Since this function enables to perform the assignment of specifications instead of using high-speed A/D units or low-speed A/D units, there is no troublesome of wiring or the noise influence caused by the analog signals.

e.g.) The boost pressure measured on the bench is output by CAN and measured using the CAN measurement function of combustion analysis. By assigning the boost pressure as the item name "Intake manifold pressure", the absolute pressure correction of the in-cylinder pressure signal can be performed based on the boost pressure.

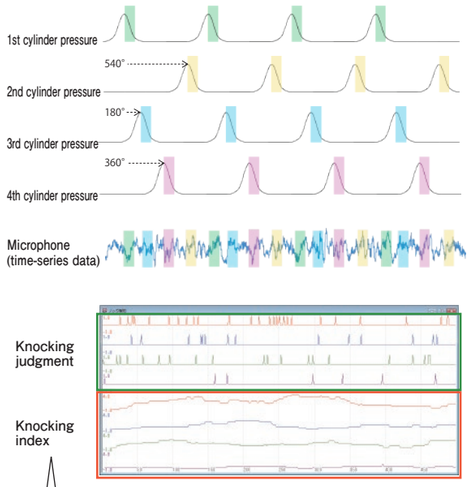
DS-0339 Knock Expert Function

The knocking phenomenon of engine is detected by the engine sound captured with a microphone. Knocking calculation is processed in real time without missing any cycles. Knocking calculation result can be displayed in the calculation monitor or trend display, and also be output in analog with the 16ch DS-0382 Combustion Analysis D/A Unit.

System configuration example



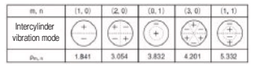
*DS-0366 2ch 100 kHz band input unit is required to purchase together.
*If you have any questions related to the purchase, please contact your nearest sales office.



Knocking index: The knocking index is defined as an index that the number of knocks per unit time is calculated by the instantaneous rotation speed. It can quantitatively evaluate the frequency of knocking regardless of the rotation speed.

Since data is cut out from the time-series data of microphone according to the processing angle range of each cylinder, it enables to perform knocking calculation for up to 4 cylinders at the same time with one microphone.
*It is not necessary to install internal cylinder sensors on all cylinders.

Perform the frequency analysis of the extracted data, judge the presence or absence of knocking for each mode (determined by cylinder bore diameter), and determine if the target cylinder has knocking or not by taking OR judgment.

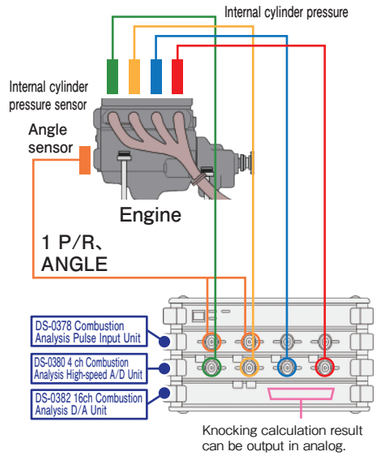


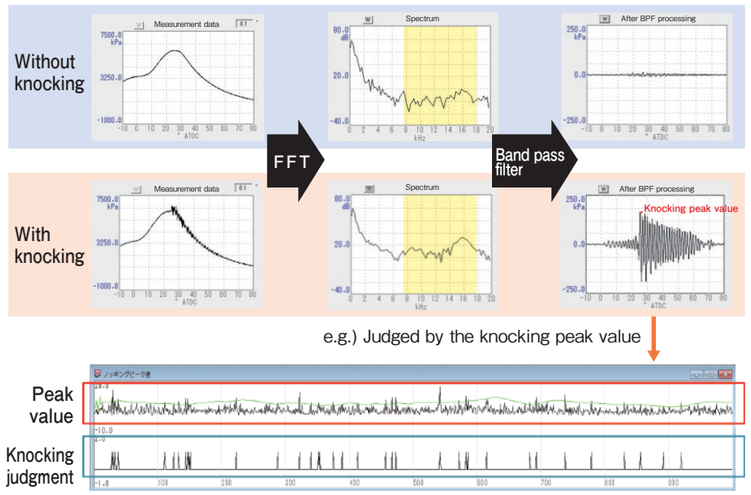
The knocking calculation results can be displayed as knocking judgment, knocking occurrence rate and knocking index in trend display, and also supports the frequency processing function, the judgment results registration and the DS-0363 calculation customization function.

DS-0329 Knocking Analysis Function

The knocking phenomenon of engine is detected by monitoring for disturbance internal cylinder pressure signals. Knocking calculation is processed in real time without missing any cycles. Knocking calculation result can be displayed in the calculation monitor or trend display, and also be output in analog with the DS-0382 16ch Combustion Analysis D/A Unit.

System configuration example



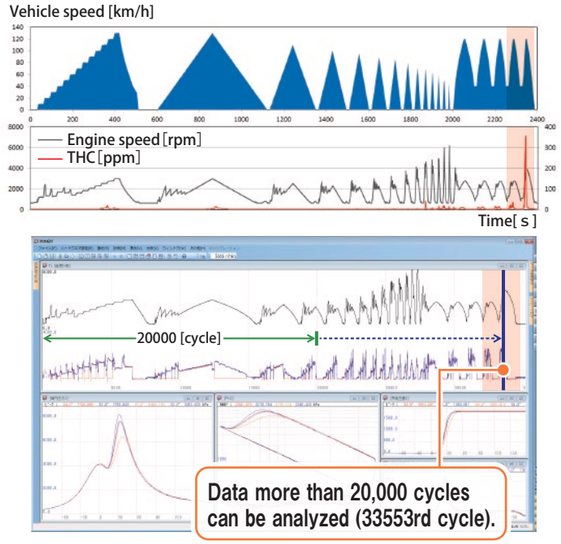


Knocking judgement is performed by indexes such as peak value, integrated value and RMS value.

DS-0328T Transient Combustion Analysis Function

With the DS-0328T Transient Combustion Analysis Function, you can measure more than the upper limit of the standard specifications (20,000 cycles).
It is effective for actual driving tests in urban areas and long run tests such as JMEC mode (test mode for creating transient emission and fuel consumption maps).
For engines that operate the idle stop function, the DS-0335 SYNC measurement function should be used. * DS-0339 Knock expert function cannot be used at the same time.

e.g.) JMEC mode test



Simultaneous throughput measurement method

In the measurement process in the standard function, the original recorded data such as internal cylinder pressure is temporarily stored in the memory of the PC, and then re-processed and saved in the hard disc area of the PC.
While, the transient measurement function operates in the simultaneous throughput measurement method by sequentially storing data in the hard disk area of the PC.
This enables it to measure for long time and multi-cycle measurement.

Narrowing down the range of analysis

Narrowing down the desired range of the overall measurement results is the most effective method for analyzing the very large data measured by the transient measurement function.
Focusing on the area around the extreme increase in THC (total hydrocarbon) emissions throughout the test, you can analyze if the combustion conditions before and after, or other items (ignition, injection timing, etc.) are appropriate. (see the graph left above)

Performance when used the DS-0328T Transient combustion analysis function

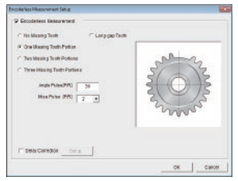
Angular Resolution [°]	The maximum number of cycles	Recording time (1,800 r/min average)
0.05	30,000	About 30 minutes
0.1	60,000	About 60 minutes
0.25	100,000	About 110 minutes
0.5	100,000	About 110 minutes
1.0	100,000	About 110 minutes

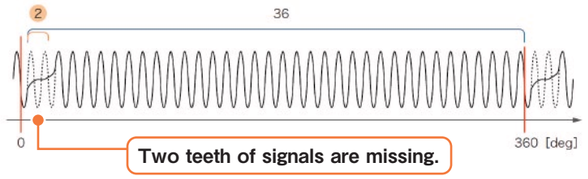
*The above is the case when the number of measurement channels is 4ch.
It varies greatly depending on the processing contents and the number of channels used.

DS-0360 Encoderless Measurement Function

The encoderless measurement function is useful when it is difficult to install a crank angle sensor such as CP-5730 or CA-6000A, or when you want to measure using a rotation signal other than the specified angle pulse. If the crank angle sensor cannot be installed, the missing teeth pulse signals equipped inside ECU are used as the rotation signals.

Setting example: one missing tooth portion

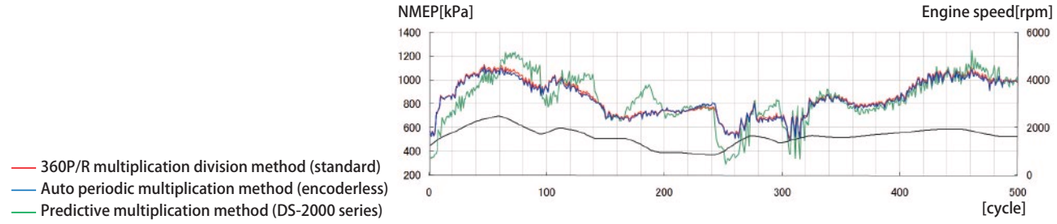




Auto periodic multiplication method

The encoderless measurement function uses the auto periodic multiplication method, which uses the pulses at that moment to perform sampling. The measurement accuracy is maintained and the measurement is stable even during transient operations.
* Predictive multiplication
Sampling method while predicting the current pulse based on the period of the previous pulse. In this method, if the number of pulses is small, the measurement accuracy may decrease especially when the measurement is made that includes transient changes, as shown in the figure below.

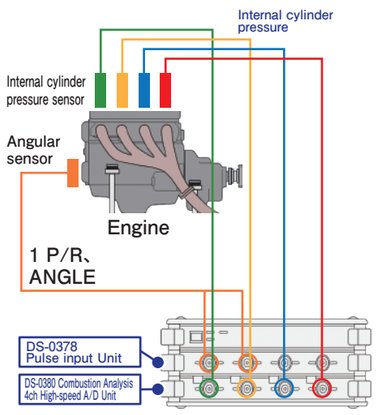
Engine start measurement with a few pulses

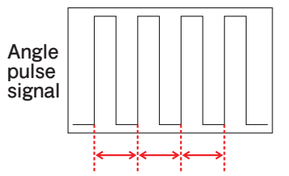


DS-0349 Crank Angle Pulse Period Measurement Function

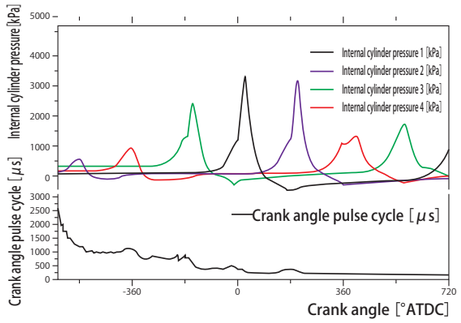
This function measure the period between crank angle pulse signals from the angle sensor. As the measurement results are recorded for each angle, it enables the user to check the fluctuations in rotation over one cycle. By using the time information for each pulse, you can improve the accuracy of text output, TDMS file output and data conversion from angle to time data in the DS-0335 SYNC measurement function.

System configuration example





※It supports the DS-0360 Encoderless measurement function. The cycle between the actual pulses of the lacked tooth signal is measured.



■ Analysis example of 4-cylinder pressure data and pulse period data

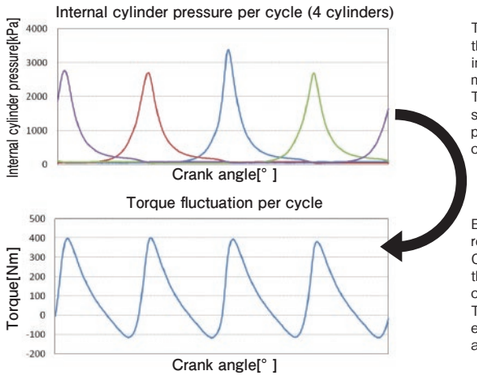
By measuring the period of the angle pulse signal used for sampling the internal cylinder pressure, the rotation fluctuation of the crankshaft in response to changes in the cylinder pressure waveform can be checked.
The measured time information can be displayed in both cycle data units [μs] and rotation speed units [rpm].
If it is the start measurement, you can evaluate whether or not the target rotation speed range has been reached with the expected number of explosions.

■ Improving the angle-time conversion accuracy

Turning on the DS-0349 Crank Angle Pulse Cycle Measurement improves the angle-time conversion accuracy.
e.g.) Absolute angle text file (time axis output), TDMS file output, DS-0335 SYNC measurement function

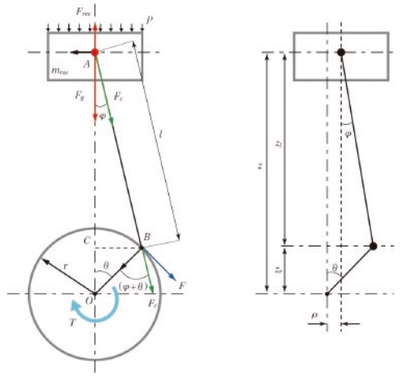
DS-0361 Torque Fluctuation Analysis Function

This function enables the calculation of engine torque data taking inertial force and frictional force into calculation based on the internal cylinder pressure of each cylinder.The torque calculation results can be displayed in the calculation monitor and the trend display. Also analog output from the DS-0382 16CH combustion D/A unit can be provided.



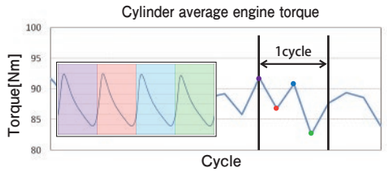
Torque is calculated based on the engine piston model from the internal cylinder pressure measured for each cylinder.
The values set in the engine specifications is used as the parameters of piston for the calculation.

By registering the calculation results in the Overlap/Multiple Cycles window, you can check the torque fluctuations within one cycle.
Torque calculation values for each angle can be output in analog form.

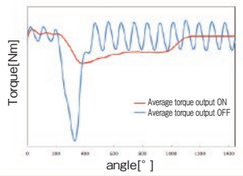


●Cylinder average engine torque

The cylinder average engine torque, which divides one cycle of the calculated engine torque by the number of cylinders and plots the average value of each section can be displayed in the trend display. It takes into account the order of cylinder explosions, which is difficult to express in the normal trend display.
For example, it makes it easier to check torque fluctuations over time when the rotation speed fluctuates rapidly.



●Image of analog output value of engine torque



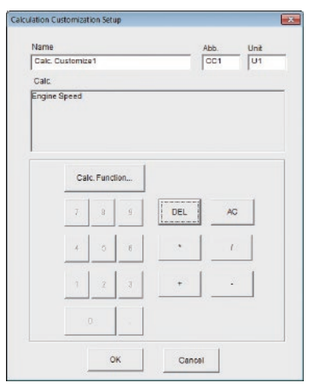
If there is a sharp fluctuation in torque within one cycle for the analog output, it can be output with a moving average filter applied for one cycle.

DS-0363 Calculation Customization Function

The customizing calculation function can create up to any 10 arbitrary calculation expressions by combining the trend calculation results that are output for each cycle and four arithmetic operations.

e.g.) When the average of knocking index for all cylinders in the DS-0339 Knock Expert function is registered,

【Average of knocking index for all cylinders】 =
Cylinder(1) knocking index + Cylinder (2) knocking index + Cylinder (3) knocking index + Cylinder (4) knocking index / 4



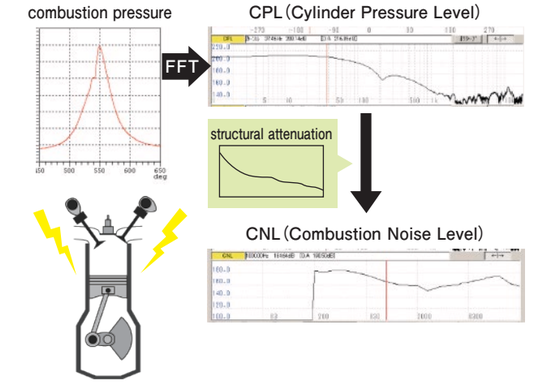
The created calculation expression is calculated at each cycle.
Like normal trend calculation results, they can be registered in the trend window and incidence calculation window, so the results can be checked during the calculation monitoring. The calculation expression can be registered in the judgment result output. The judgment results can be checked in the window, and can also be registered in the analog output and measurement start trigger.

DS-0337 Combustion Noise Analysis Function

The measurement and evaluation of combustion noise is indispensable to meet the requirements of engine noise reduction these days.
This function calculates CPL (Cylinder Pressure Level) from the internal cylinder pressure, and CNL (Combustion Noise Level) from the structural attenuation of the engine.
・Calculation monitoring, trend display, and numerical display are available.
・Combustion noise can be analyzed from the data sampled at the same angle as the combustion analysis.

Combustion noise

The internal cylinder pressure generated by combustion is transmitted through the internal structure of the engine, turns into outer surface vibrations, and is finally emitted as noise.
During the combustion noise generation process, the internal cylinder pressure energy receives a certain amount of attenuation due to the engine structures while being propagated (structural attenuation), instead of turning directly into combustion noise.



DS-0358 Multi-Stage Injection Calculation Function

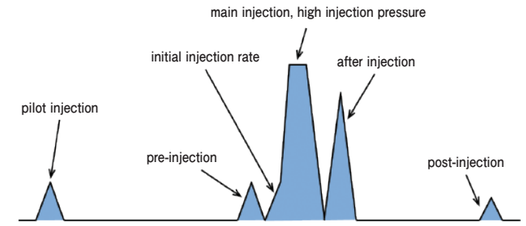
This is the analysis software for engines that inject fuel multiple times. Multi-stage injection calculation can be performed for engines that have multiple injectors. Measurement items related to fuel injection and combustion can be calculated up to 10 stages.

■Calculation items to each injection

Max. injection pressure, max. value position, valve opening pressure, fuel injection start/end position, center of gravity value for injection rate, center of gravity position, ignition delay angle

■Calculation items to each combustion

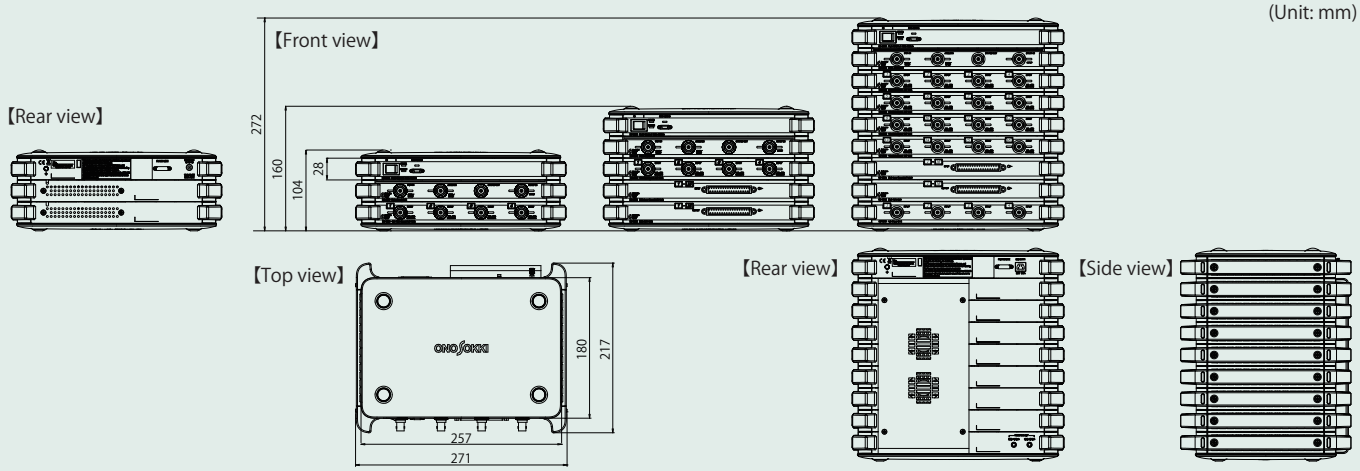
Heat release rate center of gravity position, center of gravity position, combustion start/end position, cylinder pressure and gas temperature in a combustion chamber at combustion start position



※It is necessary to input the needle value lift amount when using this function.

Outer dimensions

(Unit: mm)



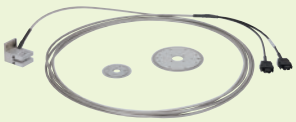
Operating environment

CPU: Intel® Core™ i5 or more
Memory: 4 GB or more
Interface: USB 3.0 interface (USB 2.0 can also be used, however data transmission speed is slower than using USB 3.0)
OS: Microsoft® Windows® 7 Ultimate / Professional (64/32-bit)
Microsoft® Windows® 10Pro (64/32-bit)
Microsoft.NET Framework 3.5 or later is supported.

Peripherals (sold separately)

Crank Angle Detector

CP-5110B
(Slit disk is required.)



CP-5730
(Slit disk is included.)

CA-6000B
Crank Angle Amplifier

Optional functions and hardware

Optional functions	DS-3000 (DS-0380)	DS-2000 B version (DS-0280B)	DS-2000 A version (DS-0280A)	DS-2000 (DS-0280)
DS-0328T Transient combustion analysis function	○	○	○	○
DS-0329 Knocking analysis function	○	○	○	○
DS-0335 SYNC measurement function	○	×	×	×
DS-0336 Combustion data link function	○	○	○	○
DS-0337 Combustion noise analysis function	○	○	○	○
DS-0339 Knock expert function	○	×	×	×
DS-0349 Crank angle pulse period measurement function	○	○	○	×
DS-0358 Multi-stage injection calculation software function	○	○	○	○
DS-0360 Encoderless measurement function	○	○*1	○*1	×
DS-0361 Torque fluctuation analysis function	○	○	○	×
DS-0363 Calculation customization function	○	○	○	○
DS-0365 INCA Link function	○	×	×	×
DS-0383 CAN measurement function*2	○	×	×	×

∗1: When the DS-2000 series is connected as measurement unit, the accuracy will be lower than when the DS-3000 series is connected.
∗2: Hardware option (VN1610 CAN interface) is required to use this function.

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∗Outer appearance and specifications are subject to change without prior notice.
URL: https://www.onosokki.co.jp/English/english.htm

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