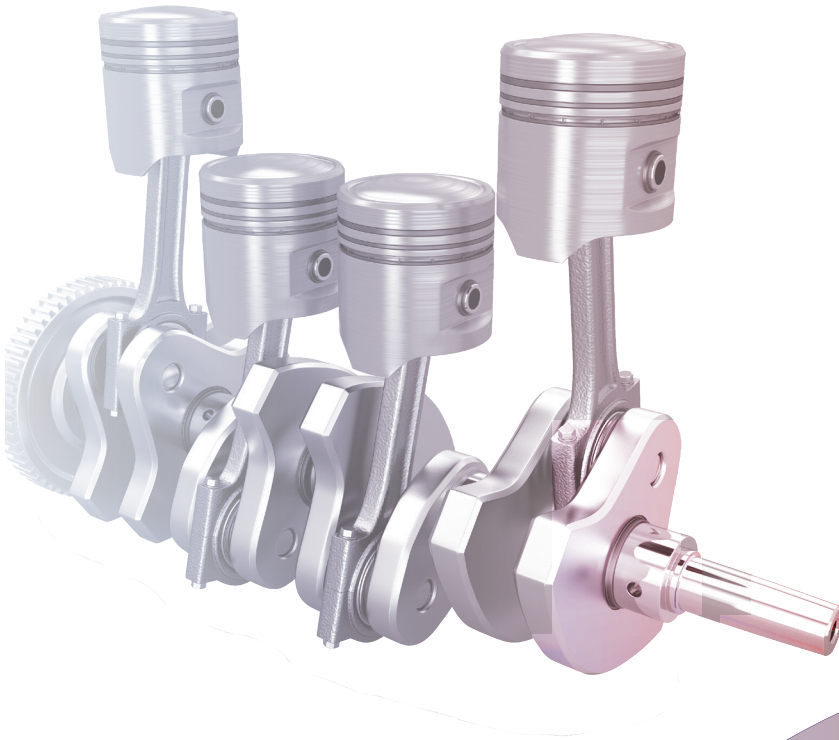


Angle Based Measurement & Analysis Software

ONOSOKKI

ExAngle

Empowering Combustion Analysis Engineers with
Next-Generation Measurement Solutions



Advanced Angle Sampling Technology Expands New Possibilities in Combustion Analysis

Combustion analysis has been instrumental in driving technological innovation in internal combustion engines in a wide range of fields. Now, the combustion analysis software has been completely redesigned. The new system, which refines the rotational angle-based measurement technology developed over many years, supports engineers working to achieve carbon neutrality.

Features

- It can be used not only for combustion analysis but also for more general-purpose high-speed angle sampling measurement.
- The NonStop architecture allows constant monitoring even during hazardous testing.
- In addition to the main recording, sub-recording can be operated simultaneously, thus you won't miss any unexpected sudden phenomena.
- The intuitive GUI reduces operational errors. It is also useful for outsourcing testing operations and expanding overseas.

Software Lineup

Basic Software

EX-4100 ExAngle

This is basic software that uses a 1MHz high-speed unit for combustion analysis and can record with a minimum resolution of 0.05 degree. Functions carried over from the existing product, DS-0328 Software

- DS-0328T Transient Combustion Analysis Function
- DS-0335 SYNC Measurement Function
- DS-0349 Crank Angle Pulse Period Measurement Function
- DS-0360 Encoderless Measurement Function

Functions not carried over from existing products

- DS-0358 Multi-Stage Injection Calculation Function
- DS-0363 Calculation Customization Function
- DS-0365 INCA Link Function
- Diesel engine mode
- Connection with DS-2000/DS-3100(ONOLINK) series

*DS-3200(USB3.0) series is only available.



Optional functions

EX-0428 DS Combustion Analysis Function

All the calculation functions of the following existing products are included, such as indicated mean effective pressure, mass fraction burned, combustion variation rate, knocking peak, combustion noise, and torque.

- DS-0328 Combustion Analysis
- DS-0337 Combustion Noise Analysis Function
- DS-0329 Knocking Expert Function
- DS-0361 Torque Fluctuation Analysis Function

EX-0436 DS Combustion Link Function

The ExAngle is controlled from the bench system via LAN communication. It can control to recording and data transmission/reception.

EX-0483 CAN Function

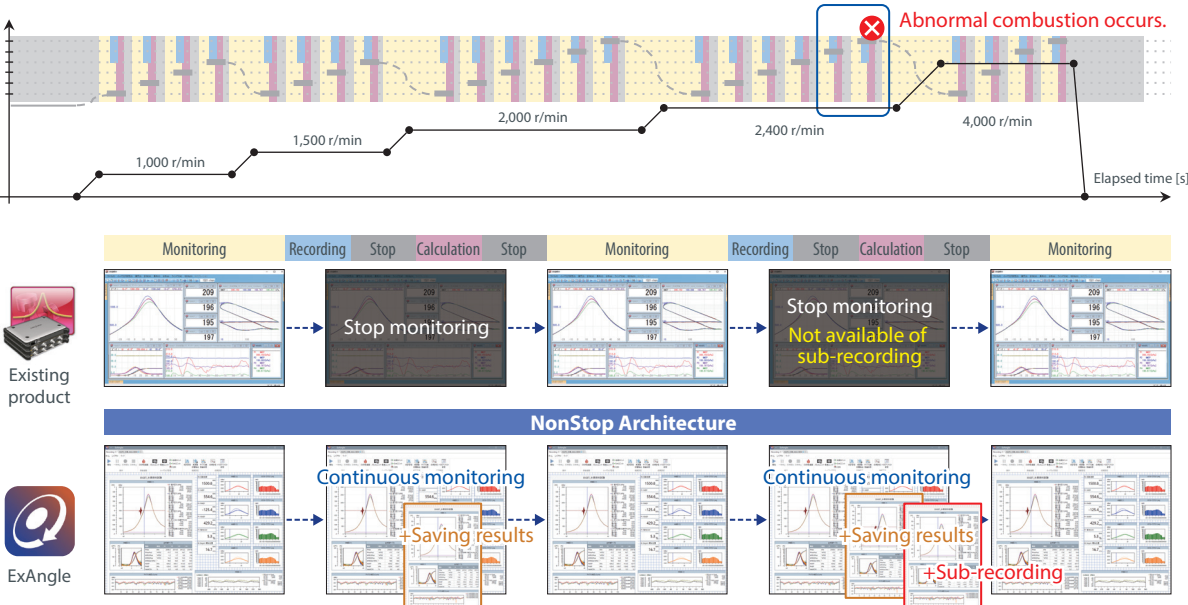
The results of ExAngle calculations can be sent to the CAN bus, and CAN information from the vehicle can be received and recorded.

EX-0439 Knocking Expert Function

By measuring engine noise with a microphone, knocking can be quantitatively indexed.

Application example

• NonStop Architecture enhances new fuel test monitoring.



The ExAngle can be used safely by operators even in situations where abnormal combustion is likely to occur during new fuel testing.

With the NonStop architecture, the monitor never stops during calculating after recording data or file saving, ensuring that abnormal combustion is never missed. The sub-recording functions allows you to record the cycle before and after abnormal combustion, and the function to notify external devices of abnormalities enable you to investigate causes and maintain equipment.

Allowable rotational speed and the maximum number of recording cycles

• At normal

Number of high-speed channels used	Measurement resolution	1.00 [°]		0.50 [°]		0.25 [°]		0.10 [°]		0.05 [°]	
		r/min	cycle	r/min	cycle	r/min	cycle	r/min	cycle	r/min	cycle
		1	4	8	12	16	20	24	28	1	4
	1	30,000	100,000	30,000	100,000	30,000	100,000	16,000	40,000	8,000	20,000
	4	30,000	100,000	30,000	50,000	26,500	25,000	12,300	10,000	6,000	5,000
	8	30,000	50,000	29,000	25,000	18,000	12,500	8,000	5,000	4,000	2,500
	12	30,000	30,000	22,500	15,000	12,800	7,500	5,700	3,000	2,800	1,500
	16	29,000	20,000	18,000	10,000	10,000	5,000	4,300	2,000	2,200	1,000
	20	24,000	20,000	14,700	10,000	8,200	5,000	3,500	2,000	1,800	1,000
	24	21,000	10,000	12,800	5,000	7,000	2,500	2,800	1,000	1,500	500
	28	18,000	10,000	10,800	5,000	5,700	2,500	2,400	1,000	1,200	500

• At using the Knocking angle resolution

Number of high-speed channels used	Knocking resolution	1.00 [°]				0.50 [°]		0.10 [°]
		0.50 [°]	0.25 [°]	0.10 [°]	0.05 [°]	0.25 [°]	0.10 [°]	0.05 [°]
		r/min	r/min	r/min	r/min	r/min	r/min	r/min
	1	30,000	30,000	16,000	8,000	30,000	16,000	8,000
	4	30,000	30,000	15,500	7,800	30,000	15,000	6,900
	8	30,000	28,700	13,800	7,100	24,700	13,100	5,700
	12	28,900	25,700	13,100	6,900	19,800	12,000	5,000
	16	25,200	23,400	12,400	6,600	16,400	11,300	4,000
	20	21,900	21,100	11,800	6,400	13,800	10,400	3,200

When using the "Knocking angle resolution," the allowable rotational speed changes depending on the combination of measurement angle resolution and knocking angle resolution. The table on the left shows the allowable rotational speed for each combination when the knocking angle resolution is set to the maximum processing angle range of 90° and the maximum number of cylinders is set to 8.

Optional functions

EX-0428 DS Combustion Analysis Function

It can monitor combustion calculations in real time. It is possible to analyze recorded data files and output files as text.

Example of combustion calculation results

- θ plot** : Internal cylinder pressure, internal cylinder pressure increase rate, heat release rate, heat release quantity, mass fraction burned, etc.
- Cycle plot** : Maximum internal cylinder pressure/ position, maximum heat release rate/position, maximum heat release quantity/position, mass fraction burned (Ignition timing 10% - 90%), NMEP, IMEP, PMEP, etc.

User friendly software

The UI has been completely redesigned to be more intuitive, easier to understand, and more user-friendly.

PV Plot

It draws a PV plot from the stroke volume and internal cylinder pressure. All cylinders is also easily overlaid.

θ Plot

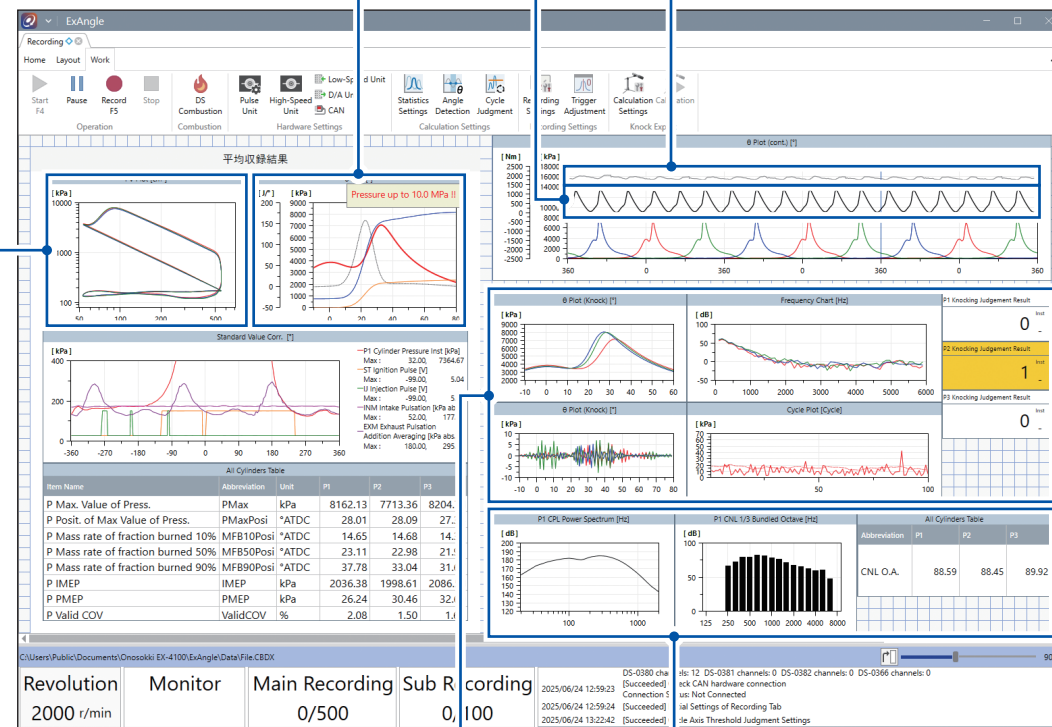
It draws the waveform of the calculation results for each angle. Up to three cycles of θplots can be displayed.

Torque fluctuation calculation

It is a function for calculating the engine torque data in consideration of inertial force and frictional force from the internal cylinder pressure.

Pulse speed measurement

This allows you to check the revolution fluctuation of the crankshaft by calculating the pulse-to-pulse period of the signals measured by the sensor.



Knocking calculation

It determines the presence or absence of knocking at each cycle based on pressure vibrations. Knocking peak values and judgment rate can be displayed and output.

Combustion noise level calculation

This function displays and outputs the noise level generated by the engine. It calculates the combustion noise level (CNL) based on the internal cylinder pressure.

Functions

Combustion analysis

By inputting crank angle pulses (1 P/R, 360 P/R) to the DS-0378 Pulse Input Unit and internal cylinder pressure to the DS-0380 High-speed A/D Unit, it is possible to perform combustion calculations based on angle sampling from internal cylinder pressure.

External trigger input

By inputting the trigger signal to start/stop recording to the DS-0378 Pulse Input Unit, simultaneous recording with other measuring instruments is performed.

STATUS OUT settings

The DS-0378 Pulse Input Unit outputs 0-5 V in sync with the recording timing of ExAngle. This allows other measuring instruments to be notified of the start of ExAngle recording.

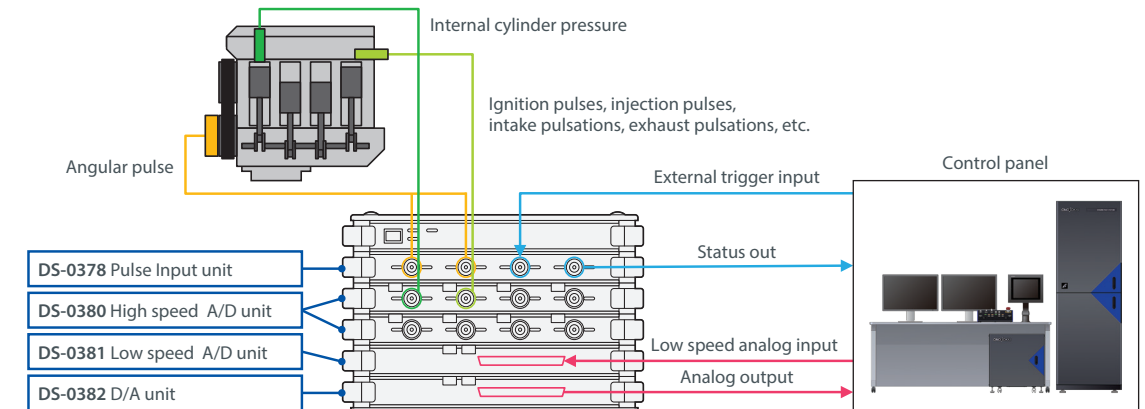
Low-Speed A/D Unit settings

By using the DS-0381 Low-speed A/D Unit, analogue data can be measured at each cycle. The measured values can also be used as parameters for combustion calculations.

Analog output

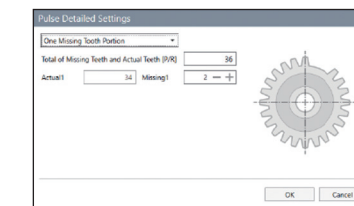
The DS-0382 16ch DA Unit outputs the results calculated by ExAngle for each cycle as voltage values.

● Hardware configurations

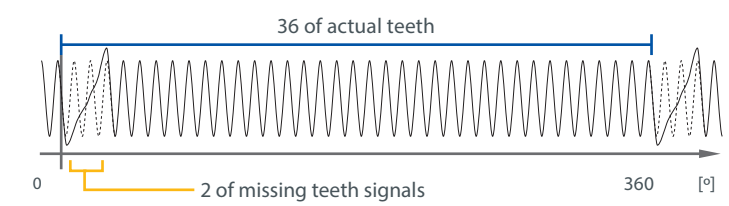


It can measure without installing a crank angle sensor.

An internal missing tooth signal equipped with the ECU can be used as a rotational signal for sampling purposes. This function is useful when it is difficult to install a crank angle sensor or when measuring on actual vehicles.



Example of setting dialog box



Reducing time required for organizing data

Text file output

Recorded data can be output in CSV format in the same format as existing products. In addition, the file format for output can be freely customized.

TDMS file output

The TDMS file can be output, which is in the data file format of NATIONAL INSTRUMENTS CORP.

Arranging and operating the canvas

You can arrange parts such as graphs on the canvas and output them as image data when recording is complete. This saves time to take screenshots or create waveforms using spreadsheet or drawing software.

Restoration function when reading CBDR file

It is possible to display, recalculate, and output the settings and recorded data of combustion analysis files with the file extension ".CBDR." (recorded files from DS-0328 software) on ExAngle.

*There are some limitations on the settings and data that can be restored.



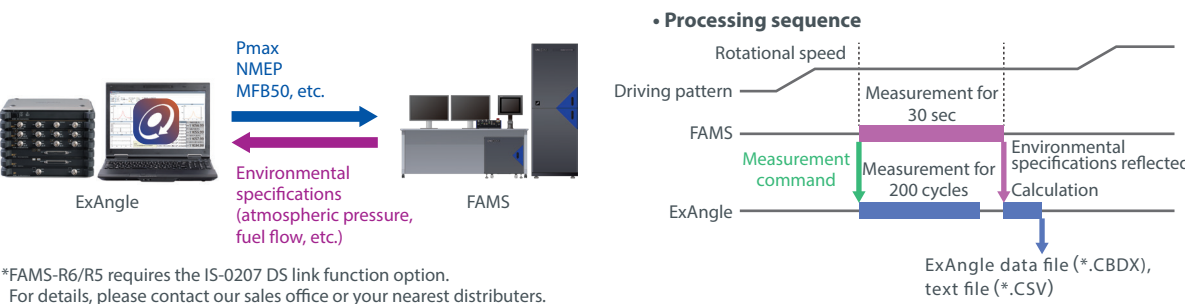
Optional functions

EX-0436 DS Combustion Link Function

This is a function for remote operation of the ExAngle Software using the socket communication function of Windows. It enables the automation of steady-state test.

- Data communication via LAN connection (TCP/IP socket)
- Simultaneous recording of performance data and combustion analysis data can be made by sending a recording start command from the bench system.
- It is possible to save ExAngle data files (*.CBDX) and text files (*.CSV) with the same names as the performance data.
- Performance data (such as atmospheric pressure and fuel flow) can be reflected in the parameters used for combustion calculations.

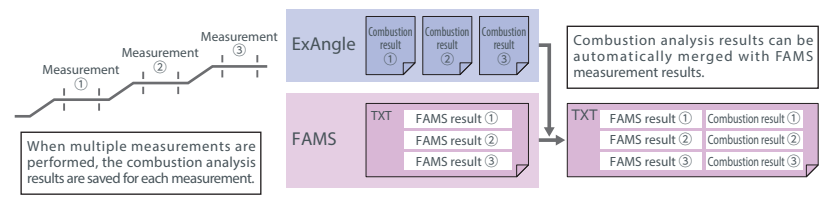
System configuration example using FAMS-R5/R6



*FAMS-R6/R5 requires the IS-0207 DS link function option.
For details, please contact our sales office or your nearest distributors.

• Data merged into FAMS

The average calculation results of combustion saved after one-step measurement can be automatically merged into FAMS recording data. After a series of steady-state step measurements are completed, combustion analysis data and performance data are available, which significantly reduces the effort required for organizing data in secondary processing.



EX-0483 CAN Function

This is a function that enables CAN communication. It is less affected by external noise, and the significant reduction in signal cables helps to minimize wiring complexity.

CAN Input : The results of each cycle for ExAngle can be recorded together with CAN communication data.

By setting CAN ID information such as atmospheric pressure and fuel flow in ExAngle, these values can be used as parameters (specifications) for combustion analysis.

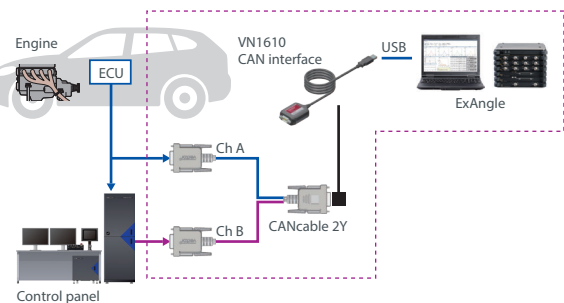
CAN output : The results of each cycle calculated by ExAngle (Pmax, NMEP, etc.) can be output.

*Compatible hardware: VN1610 (manufactured by Vector Informatik GmbH)

CAN measurement details

- CAN port : 2 channels
- Measurable items : Input 32 items (total of 2 channels)
Output 400 items
- Baudrate : 33.333 kbps/50.0 kbps/100.0 kbps/
125.0 kbps/250.0 kbps/500.0 kbps/1000.0 kbps
- Standard ID (11 bit), Extended ID (29 bit)
- Loading, outputting CANdb file (.dbc)

• System configuration example

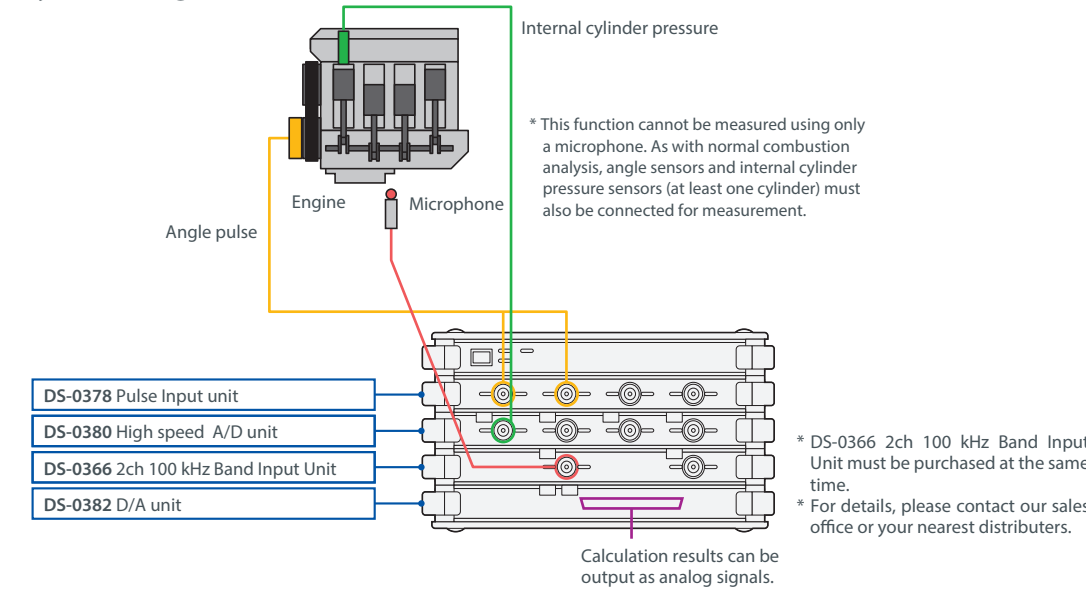


EX-0439 Knocking Expert Function

It detects engine knocking by measuring engine noise with a microphone. Knocking calculations are processed in real time without missing a single cycle.

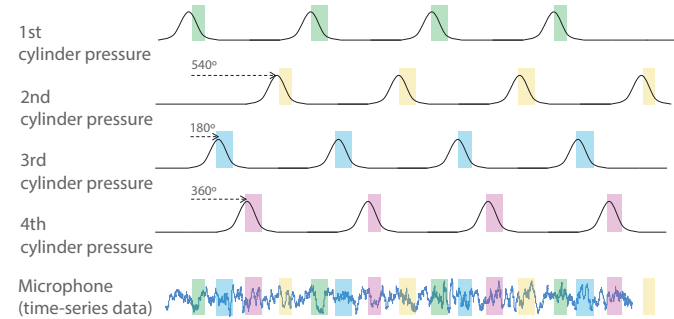
The knocking calculation results can be displayed on the calculation monitor, trend display, etc., and can also be output to the DS-0382 16ch D/A unit or CAN.

• System configurations



* This function cannot be measured using only a microphone. As with normal combustion analysis, angle sensors and internal cylinder pressure sensors (at least one cylinder) must also be connected for measurement.

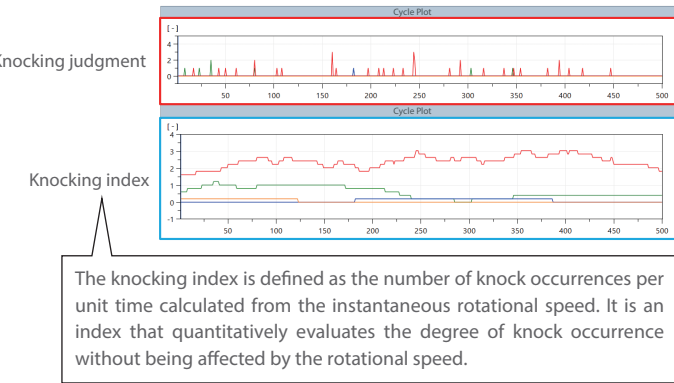
* DS-0366 2ch 100 kHz Band Input Unit must be purchased at the same time.
* For details, please contact our sales office or your nearest distributors.



Calculation for up to four cylinders with a single microphone is performed by extracting data according to the processing angle range of each cylinder from the microphone time-series data.

* It is not necessary to install internal cylinder pressure sensors on all four cylinders.

Perform frequency analysis on the extracted data. After performing frequency analysis, it makes a knocking judgment for each mode determined by the bore diameter.



m, n	(1.0)	(2.0)	(0.1)	(3.0)	(1.1)
Intercylinder Vibration mode					
Pm, n	1.841	3.054	3.832	4.201	5.332

The knocking calculation results can be displayed as a trend such as knocking judgment, knocking occurrence rate, knocking index for each cylinder and the judgement results can also be registered.

● Hardware specifications

DS-3284 4ch Combustion Analysis Unit	
Operating temperature range	0 to +40 °C (no condensation)
CE Marking	Conforming
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
① DS-3280 Combustion Analysis Main Unit	
Power supply voltage	AC adapter 65 W: rated DC10.5 to 16.5 V for 2 to 4 units AC adapter 104 W: rated DC16 V for 5 or more units
Power consumption	15 W or less (including optional units)
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/DC
Input voltage range	±10 V
Absolute maximum input range	±45 V
Minimum input voltage	1.0 Vp-p
1 P/R input	0.5/1 P/R
Angle pulse input	360/720/3600 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 4ch Combustion Analysis High-speed A/D Unit	
Number of input channels	4 CH/unit (up to 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
Input voltage range	±0.1/0.2/0.5/1.0/2.0/5.0/10.0 V
Absolute maximum input range	±50 V
Offset voltage	±100 % voltage range FS (error: ±1.0 % or less)
A/D resolution	16-bit successive conversion type
Sampling frequency	Max. 1 MHz

④ DS-0381 16ch Combustion Analysis Low-speed A/D Unit	
Number of input channels	16 CH/unit (up to 32 CH)
Input method	Single-ended
Isolation	Non-isolated
Input impedance	1 MΩ
Coupling	DC
Input voltage range	±1.0/2.0/5.0/10.0 V
Offset error	Within ±0.1 %FS
A/D resolution	16 bit Multiplex method
⑤ DS-0382 16ch Combustion Analysis D/A Unit	
Number of output channels	16 CH/unit (up to 32 CH)
Output method	Single-ended (GND common to each channel)
Isolation	Non-isolated
Output impedance	1 Ω or less
Load impedance	10 kΩ or more
Output voltage range	±10 V
Maximum output current	±1 mA
D/A resolution	14 bit
Rising time	100 μs or less (when rising from -10 V to +10 V)
Coupling	DC
⑥ DS-0366 2ch 100 kHz Range Input Unit	
Number of input channels	2 CH
Input method	Single-ended
Isolation	Isolated between each channel
Input impedance	1 MΩ
Coupling	DC or AC
Input voltage range	-40 to 20 dBVrms 7 ranges, increments of 10 dB
Residual offset voltage	-60 dB of FS or less (0 to 20 dBVrms range) -45 dB of FS or less (-40 to -10 dBVrms range)
A/D resolution	16 bit
Sampling frequency	Up to 100 kHz
Supply current for sensor	24 V/4 mA

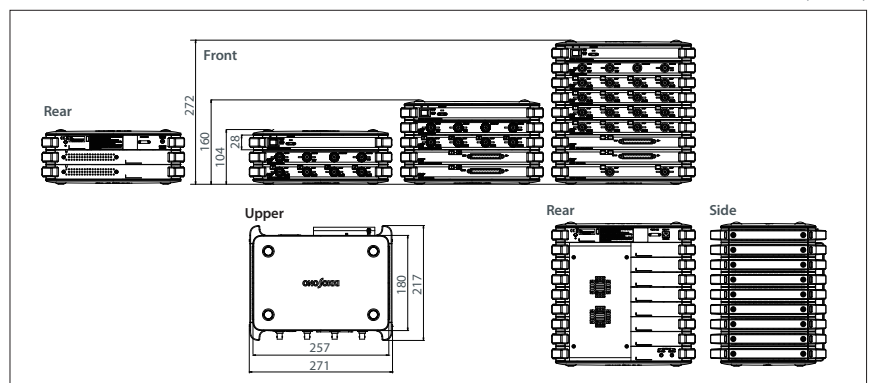


System configuration example:
8ch High-speed A/D input + 16ch Low-speed A/D input
+ 16ch D/A output + 2ch Sound/Vibration input

● Software Operating environment

OS	Microsoft® Windows® 10 Pro 22H2 Microsoft® Windows® 11 Pro 22H2 or later
CPU	Intel® Core™ i7 or higher grade, and 8th or later generation 1.7 GHz or more base clock
Memory	Minimum 16 GB (for high speed 12 CH or more, 32 GB recommended)
Drive	DVD optical drive (required at installation)
Interface	USB type A USB 3.0 × 3 ports or more (When using EX-0436, LAN terminal is required.)
Display	Full HD 1920×1080

● Outer dimensional drawing



*Outer appearance and specifications are subject to change without prior notice.

URL: <https://www.onosokki.co.jp/English/english.htm>

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