YOKOGAWA ◆

DL7400 Series

Digital Oscilloscopes

Signal Explorer

- Max.2GS/s, Max.16MW memory
- Max. Analog 8CH+Logic16-bit inputs
- 500MHz bandwidth
- Power Analysis Function (optional)
- Serial Bus (I²C, CAN, SPI) Analysis Functions (optional)
- USB memory storage supported

Analog Channels 8ch **(DL7480)** **Max. Sampling Rate** 2GS/s

+

16-bit **Logic input** 16MW **Max. memory**

DL7440/DL7480

DL7480

3-Year Warranty

The DL7400 Series is designed to make complex measurements easily

DL7480 2GS/s 500MHz DIGITAL OSCILLOSCOPE YOKOGAWA

Capture All the Signals You Want Easily, Accurately, and Reliably...

One instrument contains everything you need to observe multiple signals on analog/logic mixed circuits:
DL7440: 4 analog channels and 16-bit logic input
DL7480: 8 analog channels and 16-bit logic input

The DL7400 Series includes 4 and 8-channel analog input models. As an option, each model has up to 16-bit logic inputs. All these inputs come in a convenient, benchtop-sized instrument. In additon to capturing up to 16 logic signals, the DL7400 Series lets you simultaneously measure up to 8 analog signals without needing to synchronize two separate oscilloscopes. The DL7440 and DL7480 SignalExplorer oscilloscopes are designed for users who want an easy, efficient solution in one unit for handling measurements that required two or more units in the past.
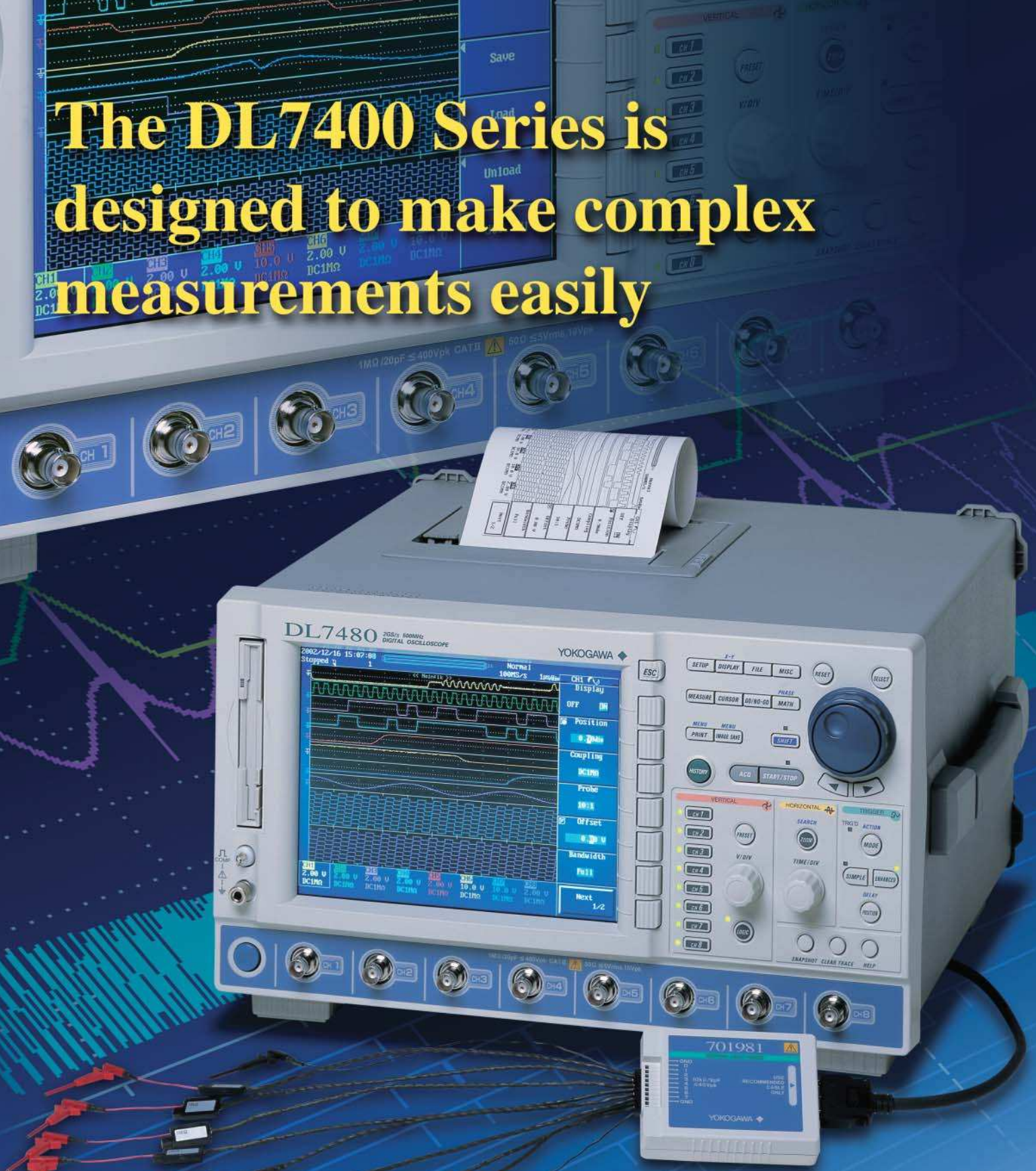
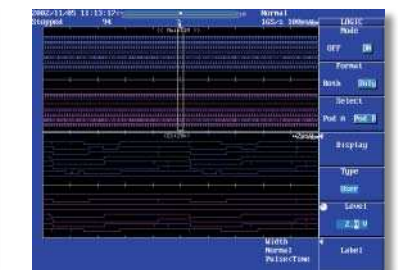Logic probe (701980)

Example of Logic Probe Connection

Logic probe (701981)

8-channel analog display

8-channel analog and 16-bit logic display

16-bit logic display

### Large Recording Memory and Quick Zoom for Accurate Waveform Capturing and Monitoring

Even some oscilloscopes with high sampling rates may not be able to accurately capture waveforms if the memory size is not large enough for the required monitoring period. This limitation is due to the necessary drop in sampling rate, which occurs if the recording memory is not long enough. A larger recording memory not only increases the monitoring time, but also enables users to maintain a high sampling rate thus ensuring accurate waveform representation. In addition, the zoom function can be used to view enlarged images on one or two segments of a waveform captured in the large memory.

Required monitoring period
With small recording memory
With large recording memory
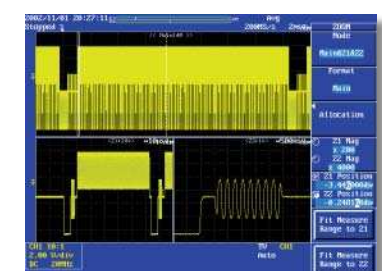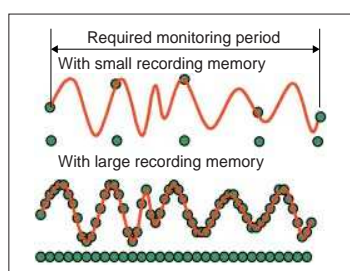
Main and dual zoom display

All-Points Display and Fast Screen Updates Make Sure You Won't Miss Abnormal Signals

When working with data captured in the large recording memory, the amount of information appearing on the display varies greatly depending on how the data are presented. The differences occur depending on whether you choose to display all points in a captured waveform, or just major values, such as maximum and minimum values, in a given segment on the waveform. The DL7400 Series provides fast screen updating in all-points display mode, so you won't miss abnormal phenomena or have slow responses to instrument controls.
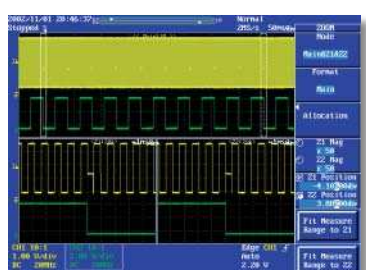
All-points display
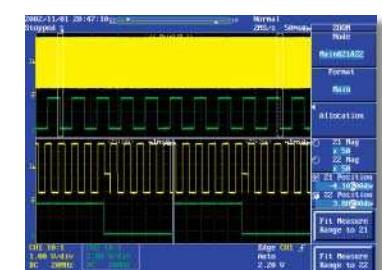
Conventional compression display

DL7400 Series Models lineup

Item	Model	DL7440		DL7480	
		701450	701460	701470	701480
Analog input channels		4	4	8	8
Logic input channels		16-bit			
Max. sampling speed		2GS/s			
Bandwidth		500MHz			
Max. record length		4MW/ch	16MW/ch	4MW/ch	16MW/ch

A Variety of Functions to Help You Find Useful Information in Large Amounts of Data

When an abnormal signal is displayed on the screen, does it disappear before you can press the STOP key?

History Memory

The history memory function divides the large recording memory into a number of blocks and automatically saves up to 4096 previously captured waveforms. You can increase the number of screens that can be saved to history memory by setting a shorter record length.
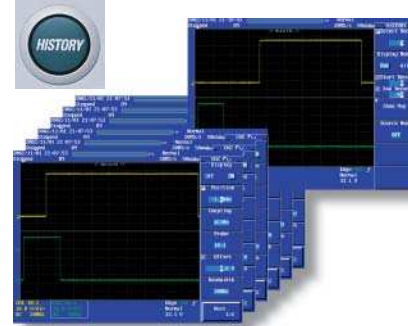
History Search

The history search function is useful for quickly finding abnormal waveforms in the large amounts of waveform data stored in history memory. This function lets you automatically search for desired waveforms based on whether or not a signal passes through a user-defined area on the screen. You can also conduct searches based on waveform parameters.

History Statistics

Calculates statistical information based on the parameter values for waveforms stored in history memory. This function calculates and displays a parameter's maximum value, minimum value, average value, and standard deviation. You can check the parameters for every waveform in history memory.
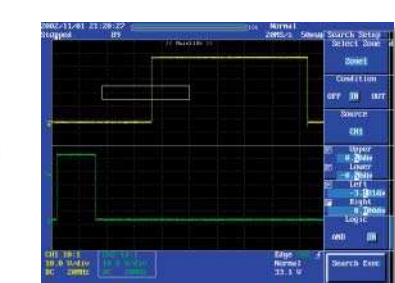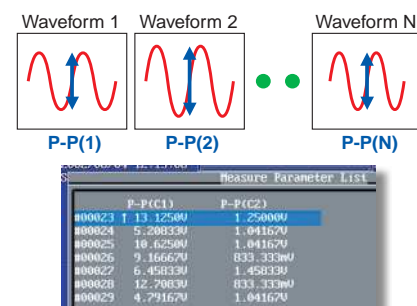
Waveform 1   Waveform 2   Waveform N

P-P(1)   P-P(2)   P-P(N)

Measuring Periodically Fluctuating Amplitudes

Cycle Statistics

Automatically calculates the maximum value, minimum value, average value, and standard deviation of selected waveform parameters for each period of a signal. You can even find the period corresponding to the calculated maximum and minimum values and display that period in the zoom window. In some applications, like with a PWM (pulse width modulation) control signal, you may need to determine information about each waveform period for long amounts of time. The DL7400 Series with its long memory, lets you analyze a long waveform, period-by-period, based on the period of a reference signal.

Example Applications
• Amplitude, period, and duty ratio of each period in a modulated signal
• Current, voltage, and period for each switching cycle as the load fluctuates in a switching power supply
• Each signal level in clock-synchronized CCD output
• Output level of each sensor per revolution in engine or motor

How can I quickly count a large number of pulses in a waveform?

Pulse Count

Automatically counts the number of pulses in the waveform data between cursors. The threshold level for recognizing a single pulse is user-definable, so you can reliably compute pulses even in signals with unstable levels. With the DL7400 Series, you'll never again have to manually count pulses on screen or on a stack of printouts.

Example Applications
• Stepping motor revolution pulses
• Optical disk tracking error signals
• Interrupt signals from microcontrollers
• Clock count in serial data

A Variety of Triggers to Help you Catch the Signals You Want

Simple and Enhanced Triggers

The many trigger types in the DL7400 Series enable stable monitoring of a wide range of waveforms.

Edge trigger : Triggers on a rising or falling edge.
A → B (N) : Triggers when condition B is satisfied N times after condition A has been satisfied.
A Delay B : Triggers when the first condition B is satisfied a set length of time after condition A has been satisfied.
Pattern : Separate trigger conditions are set for each channel. Triggers when the combination of trigger conditions is satisfied at an edge of the clock channel signal.
Width : Triggers when a comparison of the input pulse width and a specified time width satisfies a condition. (Pulse > Time; Pulse < Time; T1 < Pulse < T2; Time Out)
OR : Triggers activate when one or more of the specified trigger conditions are satisfied.
TV : NTSC, PAL, SECAM, HDTV (8 types)
Logic : Triggers when the specified combination of the H, L, or "Don't care" conditions are met on up to 16 logic inputs (optional).
I²C : Triggers when the specified I²C Bus bit pattern is satisfied (optional).
CAN : Triggers when the specified CAN Bus bit pattern is satisfied (optional).
SPI : Triggers when the specified SPI Bus bit pattern is satisfied (optional).

A Variety of Optional Functions to Provide you a Best Solution for your Application

## Power Analysis Functions (with the /G4 option)*1

Indispensable measurement tools for design and evaluation of power supplies

Easy, automatic calculation of power supply parameters including: switching loss, power, power factor, impedance, energy, and more.

From the main Power Analyze Setup menu, you can select which channels will be used for power measurements. For each channel selected, you can choose from a number of waveform parameters specific to power analysis. (For example, I²t can be calculated for fuse measurements).
Additionally from the main Power Analyze Setup menu, you can jump to the Auto Deskew function or the Power Analysis Math and Parameter Measurement menus.

Automatic parameters available on voltage channels
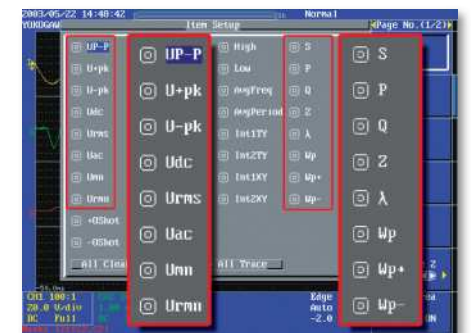
Measure and display how parameters change for each waveform period

Fluctuations in waveform parameter values of acquired signals are displayed on a plot. For example, on an active power factor correction circuit, you can simultaneously display fluctuations in the switching frequency and switching current of the modulating signal relative to the commercial power supply and input voltage.
Also, you can measure commercial power supply voltage and current and then display the trend of power consumption over each cycle.

You can measure commercial power supply voltage and switching voltage/current in active power correction circuits, and also plot fluctuations in switching frequency and switching current.
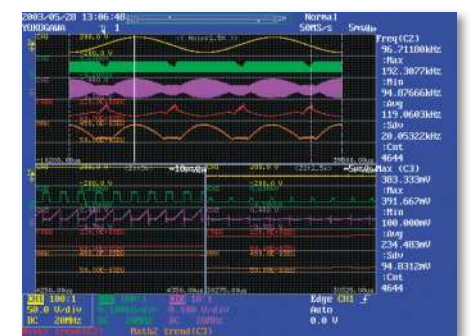
Harmonic analysis of the power supply current allows for easy comparison to EN61000-3-2 standards*2

Limit values based on EN61000-3-2 class A, B, C, and D can be superimposed with measured data.
Limit values and numeric data values are displayed together in a list. Data exceeding the limit value are flagged.

Analysis Results Display

*2 You can use the DL7400 for pre-complaince testing.
Use Yokogawa's WT2000 Digital Power Meter for standards compliance testing.

List Display
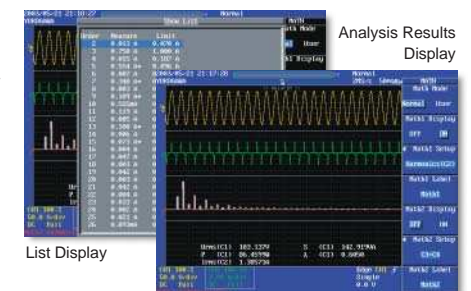
Easily adjust the skew between voltage and current probes

Adjust for differences in electrical length (skew) between voltage probes and current probes. This is useful for switching loss measurements and other measurements affected by voltage/current signal skew. Deskew can be performed automatically or manually for each channel.

701933
50MHz Current Probe

■ **Deskew signal source (701935)**
Output voltage: Approx. 0 to 5 V
Output current: Approx. -100 to 0 mA
Output freq: Approx. 15 kHz
Fall time: Approx. 15 nsec

701921
100MHz Differential Probe

*1 The Power Analysis Functions (/G4 option) includes the User-Defined Math (/G2 option).

User-Defined Math (with the / G2 option)

The DL7440 and DL7480 include addition, subtraction, multiplication, binary conversion, inversion, differentiation, integration, and power spectrum (FFT) as standard math functions. With the optional user-defined calculations, you can define equations using arithmetic calculations as well as a variety of other functions, including trigonometric functions, differentials, integrals, square roots, digital filters, six different FFT functions, and pulse width calculations. In addition, calculation results can be specified as parameters for other equations, so the DL7440 and DL7480 can directly handle complex computations that formerly required data to be uploaded to a PC for computation.

A Variety of Optional Functions to Provide you a Best Solution for your Application

Serial Bus Analysis Functions (with the /F5, /F7 or /F8 options)

Three serial bus analysis functions (I²C, CAN, and SPI) are available together "in one instrument."
These options provide physical-layer observation and analysis of serial bus signals. Evaluations from such analyses are essential to solve communication failures resulting from signal deterioration and unpredictable external noise.

I²C Bus Trigger and Analysis

I²C bus signals (SCL and SDA), used extensively in home electronics such as analog and digital televisions, and video cameras, and in communications equipment such as mobile phones can be captured with specialized triggers and displayed as waveforms. Triggers can be based on start conditions, user-specified address and data patterns (Data 1 and Data 2), non-ack (when acknowledgement is not received), and other conditions for reliable capturing of I²C signals. You can also set triggers based on combinations of I²C bus trigger conditions (SCL and SDA) and signal inputs on channels 3-8 (combination triggers).
Captured waveforms can be analyzed in a time-series manner, and the analysis results at each byte is displayed in a list along with the presence/absence of ACK field codes. When an analysis result is selected with the cursor, the corresponding portion of the waveform is automatically enlarged in the zoom area.
You can quickly search the analyzed results for a specific address or data pattern from within the analysis results.
Two pairs of I²C busses can be input at the same time (SCL: CH1 & CH3; SDA: CH2 & CH4), and then analysis can be performed alternately on either bus.

SCL

SDA

SCL

SDA

Device #1   Device #2
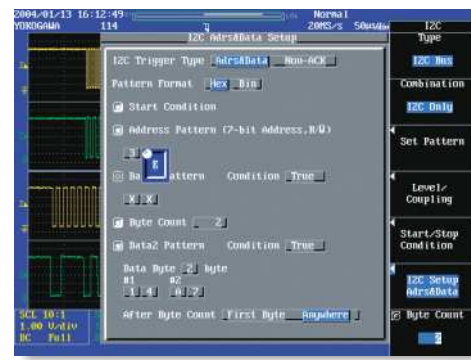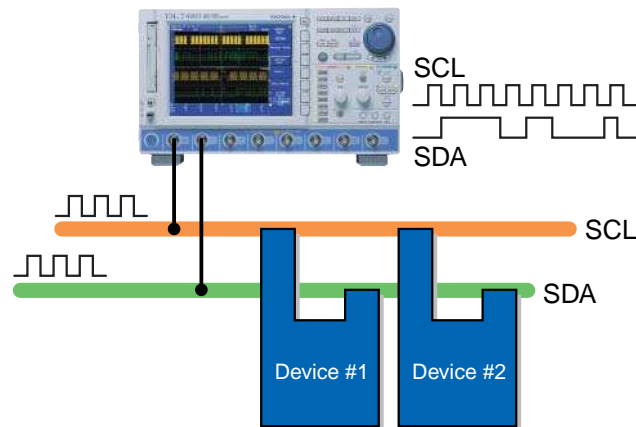
I²C Address and Data Trigger Setup Menu
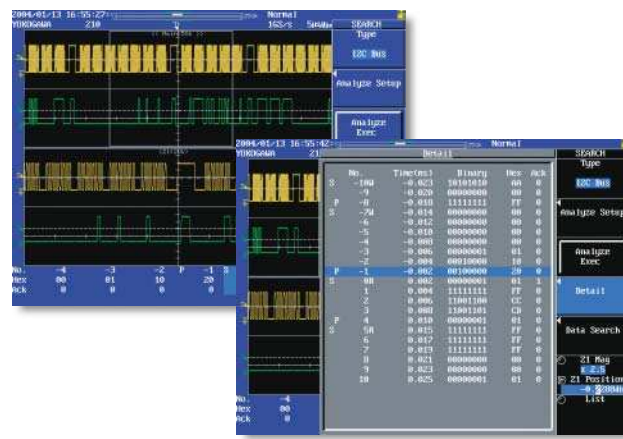
I²C Bus Analysis Results Display

CAN Bus Trigger and Analysis

Using dedicated triggers, CAN bus signals can be captured and displayed as waveforms. (The CAN bus option supports both high-speed and low-speed CAN. CAN is used widely in the internal communication busses of automobiles, FA machinery, medical equipment, and other devices.) Analysis performed according to the CAN protocol can be displayed in a list together with the waveforms. Two types of differential probes are available for measuring CAN bus signals (sold separately).
Trigger conditions can be set from fields or combinations of fields in CAN data frames (ID, Data, RTR bits, etc.), enabling reliable capturing of CAN bus signals. Triggers can also be activated on an error frame.
Captured CAN bus waveform data can be analyzed in a time-series, and the ID and Data at each frame displayed in hexadecimal or binary notation. Frame and error types can also be displayed simultaneously. By selecting a frame with the cursor, you can display an enlarged version of the corresponding portion of the waveform on the screen.
Search the analysis results for a specific CAN frame - ID, Data, Remote (RTR) or Error frame. The specified field is automatically identified and displayed in the on-screen zoom window.
A waveform showing the stuff bit position can also be displayed.

High-speed CAN (ISO11898)

Node 1   Node n

CAN_H

CAN_L

Dominant (0),Recessive (1)
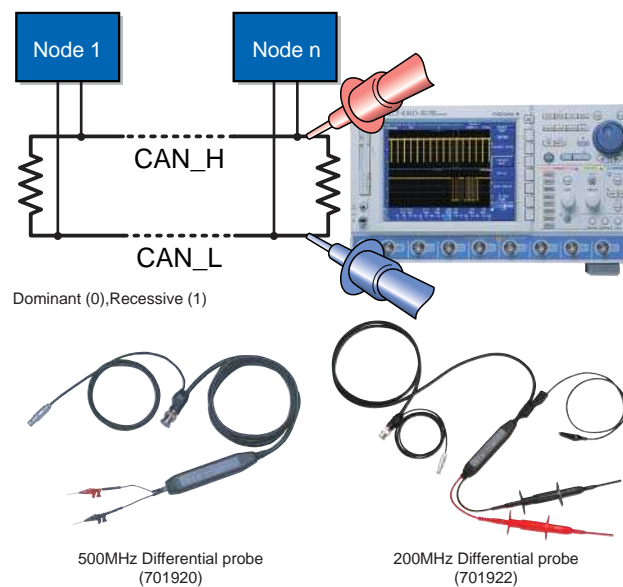
500MHz Differential probe
(701920)

200MHz Differential probe
(701922)

Serial Bus Analysis Functions (with the /F5, /F7 or /F8 options)
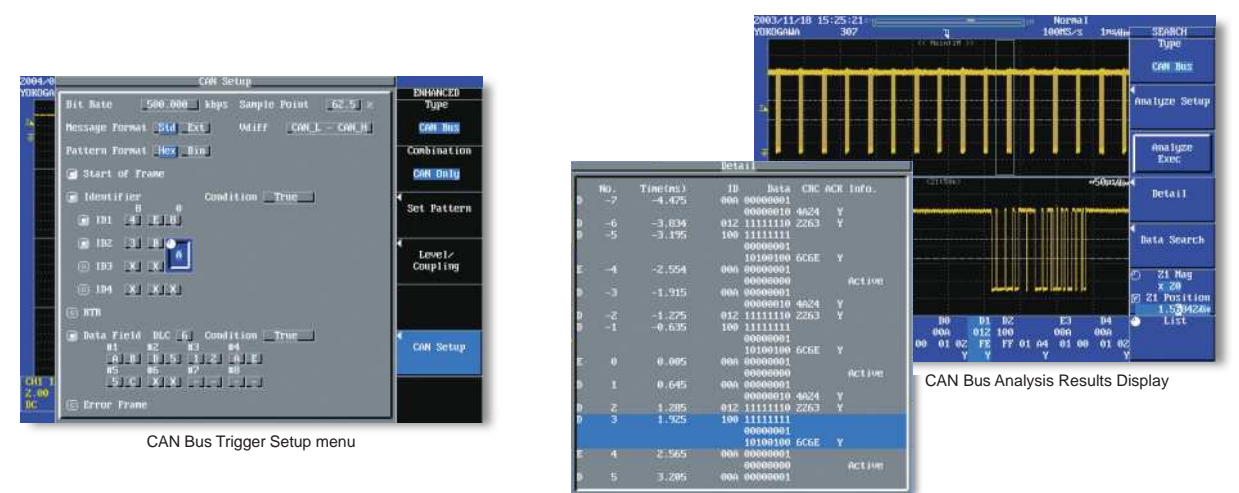
CAN Bus Trigger Setup menu

CAN Bus Analysis Results Display

SPI Bus Trigger and Analysis*

Signals in the SPI bus, a synchronous 8-bit serial bus widely used for inter-IC and data communication in embedded systems and in other applications, can be captured using dedicated triggers. The captured results are then analyzed based on the SPI protocol and can then be displayed together with the waveform.

Triggers are activated on user-defined conditions of the MOSI (master output slave input) and/or MISO (master input slave output) data signals on the SPI bus. Data strings of 1-8 bytes can be defined.
Two types of trigger patterns can be set (A pattern, B pattern, or both), allowing a trigger to be activated, for example, upon data read out from the slave (MISO, pattern B) in response to a specific command from the master (MOSI, pattern A).
Data analysis results and SS (slave select) bits can be displayed in a list together with the waveforms.
After analyzing the acquired data, you can perform high speed searches for a specific MOSI or MISO data pattern (1-8 bytes).

Master

For other signals

SS 2

SCK

MOSI

MISO

SS 1

Slave 1

Clock

Data

SS

Slave 2
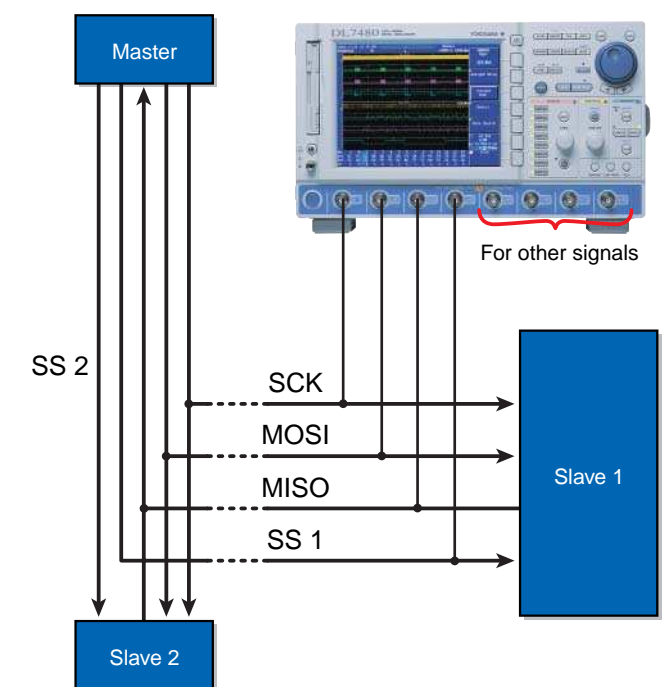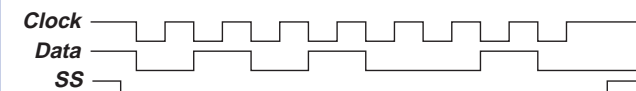
Example of a connection to a SPI bus
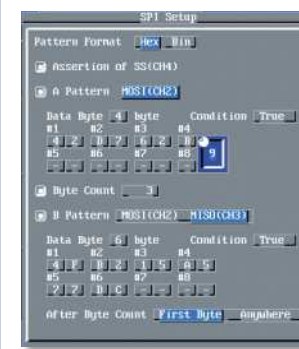
SPI Bus Trigger Setup menu
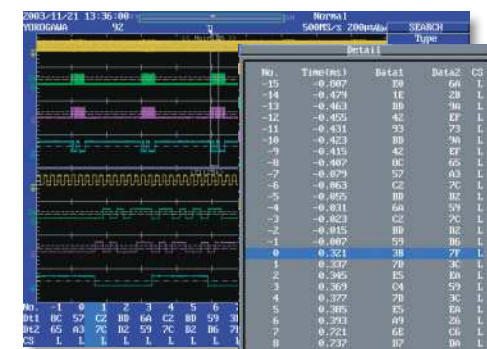
SPI Bus Analysis Results Display*
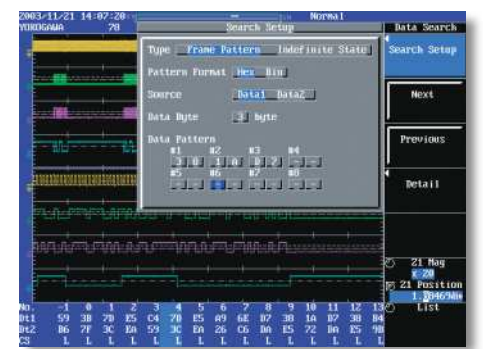
SPI Bus Data Search Setup menu*

* The SPI Bus Analysis and Search functions are standard features. The SPI Bus Triggers are available only as an option.

Connection with a Wide Range of Peripherals such as PC, Printer

Connecting with PC via WebDAV*

Using the Windows XP WebDAV* function, the DL7400's internal storage media drives (Floppy, ZIP®, PC Card) can be mounted as a PC network drive.
Using your PC, you can then access stored data on these drives as easily as you would access data on the PC's own hard drive. This feature does not require any external FTP client software.
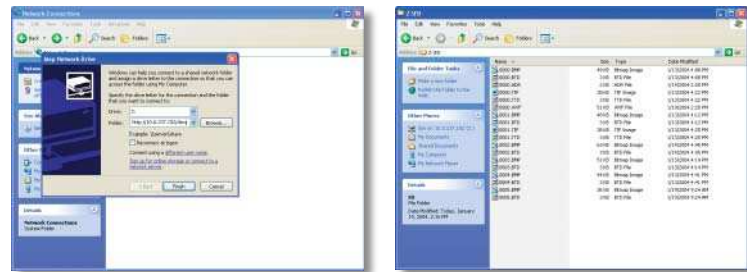
* Web-based Distributed Authoring and Versioning

Ethernet (with the /C10 option)

Web Server
With an Ethernet connection, you can perform various functions using Internet Explorer.

• **FTP**
Easily copy and paste files from the DL7400's internal storage devices to a connected PC or network drive. This internal storage device functions as one of your PC file servers.

• **Data Capture**
Perform actions such as waveform monitoring, uploading settings, and starting/stopping measurements.
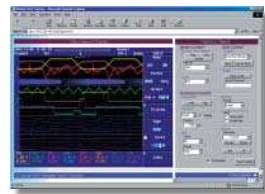
• **Measurement Trend**
Automatically opens Excel, then periodically downloads waveform parameter values and graphs them. Easily monitor parameter trends during extended-period measurements.
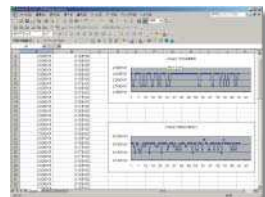
• **Printng on a Network Printer**
The screen image can be printed on a network printer in the same way as you would print to the internal printer or a USB printer.

• **Transmitting E-mails**
The information of the DL7440/7480 can be transmitted periodically in an e-mail message to a specified mail address.

USB

Peripheral Device Connections
• The DL7400 Series can be completely controlled using a USB mouse.
• File names can be entered using a USB keyboard.
• Connect a USB printer for color printouts.
• Connect a USB flash memory for saving a variety of data (ACQ data, setup data, Screen image data)

PC Connection
You can create a PC program to remotely control the DL7400 via USB. This is similar to how you would control operations via GP-IB.
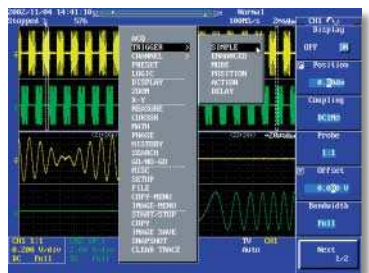
Controlling the DL7400 Series using a USB mouse

Outputting and Viewing screen Images

The PRINT key lets you print screenshots to the built-in printer, a USB printer, or a network printer.

Simply press the IMAGE SAVE key to save a screenshot to a PC card or other storage device. Screenshots can be saved in BMP, TIFF, PS, PNG, and JPEG formats.

Captured images can be easily checked as thumbnail icons. File names are displayed together with the thumbnail images, allowing you to check files and immediately change their names or delete them if necessary.

Rear Panel

Probe Power Connectors
Probe power connectors for active probes and for the 701935 Deskew signal source.
The DL7400 Series comes standard with 4 connectors. 4 additional connectors can be added as an option.

RGB Video Signal Output Connector
Outputs a video signal for viewing waveforms on an external monitor.

USB-PC Connector
Complies with USB Rev. 1.1

USB Peripheral Device Connectors
Type A connectors: 2 ports compatible with USB Flash memory*, HD drive*, USB printers, keyboard and mouse.

Logic Inputs
Logic probe connectors. Two 8-bit logic probes can be connected. (701980 and 701981 logic probes sold separately)

SCSI (optional)

Ethernet (optional)
Complies with 100BASE-TX and 10BASE-T.

GP-IB

PC Card Interface
Flash ATA card (PC card Type II)

External Trigger Input/External Clock Input/Trigger Gate Input
Inputs DC to 100 MHz signal for external triggering (external trigger input).
Inputs clock signal from 40 Hz to 20 MHz from exterior (external clock).
Trigger occurrence can be controlled using external signal (trigger gate input).

Trigger Output
Outputs TTL level trigger signal.

*: Availabe only when the following is displayed in the Overview screen. "USB Storage Yes"
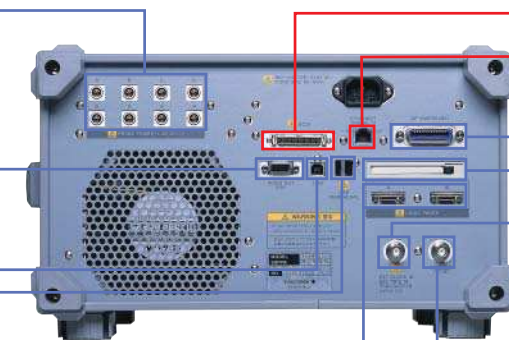
Software

Xviewer (701992)
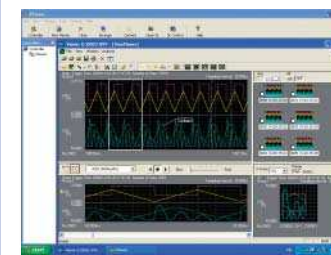
Xviewer is a PC software application designed to work with Yokogawa's DL series digital oscilloscopes and the DL750 series ScopeCorders. Xviewer allows you to display DL-acquired waveform data (using the "Viewer" function), perform file transfers, and control DL series instruments remotely.

You can download a trial version of Xviewer from YOKOGAWA's web site at: http://www.yokogawa.com/tm/701992/

MATLAB tool kit (701991)
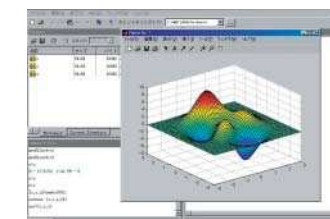
The MATLAB tool kit for the DL series is a plug-in for MATALAB software. The toolkit can be used to control supported DL series instruments using MATLAB or to acquire data from a DL series instrument for use in MATLAB via a communication interface (GP-IB, USB, Ethernet).

You can download a trial version of MATLAB tool kit from YOKOGAWA's web site at: http://www.yokogawa.com/tm/701991/

Accessories

Miniature passive probe[1] (701941)
500MHz bandwidth, 1.2m long
Standard accessories: Basic Accessories set B9852HF-see right.

Basic accessories set for the 701941 probe (B9852HF)
11 accessories are included in this set.[2]

900 MHz band FET probe (700939)
Input range: 15 Apeak

50 MHz band current probe (701933)
Input range: 30 Arms

10 MHz band current probe (701930)
Input range: 150 Arms

500 MHz band differential probe (701920)
Attenuation ratio: 1/10 with 50 Ω load
Input differential voltage range: ±12 V

100 MHz band differential probe (700924)
Attenuation ratio: Can be switched between 1/100 and 1/1000
Maximum differential allowed voltage: ±1400 V

100 MHz band differential probe (701921)
Attenuation ratio can be switched between 1/10 and 1/100
Max. differential allowed voltage: ±70 V/(1/10), ±700 V/(1/100)

200 MHz band differential probe (701922)
Attenuation ratio: 1/10
Max. differential allowed voltage: ±20 V

Deskew signal source (701935)
Output voltage: Approx. 0-5 V
Output current: Approx. –100 to 0 mA

Logic probe (701980)
Input impedance: 1 MΩ
Max. toggle frequency: 100 MHz

Logic probe (701981)
Input impedance: 10 KΩ
Max. toggle frequency: 250 MHz

*1: 701941 probes including the basic accessories set are included with the main unit when the /EX4, /EA4 options are specified.
*2: The B9852HF contains the following eleven(11) kinds of accessories.
(Insulation cap, IC cap, BNC adapter, Rigid tip, Spring tip (Ø: 0.80 mm), Spring tip (Ø: 0.38 mm), Ground spring, Adjustment tool, Pincher tip, Standard ground lead, Color coding rings)

Specifications

Basic Specifications

Input channels:	4/8 analog (depends on model), and 16-bit logic
Input coupling settings:	AC 1 MΩ, DC 1 MΩ, GND, DC 50 Ω
Input impedance:	1 MΩ ± 1.0%, 50 Ω ± 1.0%

Voltage axis sensitivity setting range:
- For 1 MΩ input: 2 mV/div to 10 V/div (steps of 1, 2, or 5)
- For 50 Ω input: 2 mV/div to 1 V/div (steps of 1, 2, or 5)

Maximum input voltage:
- For 1 MΩ input (frequency of 1 kHz or less): 400 V (DC + ACpeak) (282 Vrms CAT II)
- For 50 Ω input: 5 Vrms or less and 10 Vpeak or less

Frequency characteristics[1]:
- For 1 MΩ input: (using passive probe model 700988; specified at probe tip)
  - 10 V/div to 10 mV/div: DC to 400 MHz (500 MHz[4])
  - 5 mV/div to 2 mV/div: DC to 300 MHz (400 MHz[4])
- For 50 Ω input: 1 V/div to 10 mV/div: DC to 500 MHz
  - 5 mV/div to 2 mV/div: DC to 400 MHz

A/D conversion resolution:	8 bits (24 LSB/div)

Maximum sampling rate:
- Real-time sampling mode:
  - Interleave mode on: 2 GS/s[2]
  - Interleave mode off: 1 GS/s
- Equivalent time sampling mode: 100 GS/s

Maximum record length:
- 701450/701470
  - Interleave mode on: 4 MW/channel[2]
  - Interleave mode off: 2 MW/channel
- 701460/701480
  - Interleave mode on: 16 MW/channel[2]
  - Interleave mode off: 8 MW/channel

DC accuracy[1]:	±(1.5% of 8 div + offset voltage accuracy)

Offset voltage axis accuracy[1]:
- 2 mV/div to 50 mV/div ±(1% of setting + 0.2 mV)
- 100 mV/div to 500 mV/div ±(1% of setting + 2 mV)
- 1 V/div to 10 V/div ±(1% of setting + 20 mV)

Time axis setting range:
- 1 ns/div to 50 s/div (for record length of 10 kW or greater)
- 1 ns/div to 5 s/div (for record length of 1 kW)

Time base accuracy[1]:	±0.005%
External clock input:	Input frequency range: 40 Hz to 20 MHz (continuous clock signal only)

Trigger

Trigger modes:	Auto, Auto Level, Normal, Single, Single (N)
Trigger sources:	CH1 through CH8 (the number of channels depends on the model; signals input to individual input terminals), LINE (connected utility power signal), EXT (signal input from EXT TRIG IN terminal)
Trigger types:	Edge, A → B (N), A Delay B, OR, Pattern, Pulse Width, TV, Logic, I²C (optional), CAN (optional), SPI (optional)

Display

Screen updating rate:	Maximum 60 times per second (for 10 kW all-points display)
	Maximum 30 times per second (for 1 MW all-points display)
Display:	8.4-inch color TFT liquid crystal display

* Note that an LCD may contain some pixels which always glow or never glow or may have uneven brightness due to its characteristics. These are not indications of an equipment problem.

Functions

● Vertical/horizontal axis setting function

Input filters:	100 MHz or 20 MHz band limits can be set independently for CH1 through CH8 (the number of channels depends on the model).
Roll mode:	Roll mode display on the time axes shown below when trigger mode is Auto, Auto Level, or Single

- For record length of 1 MW or lower: 50 ms/div to 50 s/div (or 50 ms to 5 s/div for 1 kW)
- For record length of 2 MW: 100 ms/div to 50 s/div
- For record length of 4 MW: 200 ms/div to 50 s/div
- For record length of 8 MW: 500 ms/div to 50 s/div
- For record length of 16 MW: 1 s/div to 50 s/div

● Waveform acquisition/display functions

Acquisition modes:	Normal, Envelope, Averaging, Box Average
Zoom:	Zoom in on displayed waveforms along the time axis (one or two zoom windows with separate enlargement ratios)
X-Y display:	Two X-Y waveform displays (XY1 and XY2)

● Analysis functions

Search-and-zoom functions:	Edge, serial pattern, parallel pattern, pulse width, auto scroll
History search functions:	Zone, parameter
Cursor measurements:	Horizontal, Vertical, Marker, Degree, H&V

Automatic measurement of waveform parameters:
- P-P, Max, Min, Avg, Rms, Sdev, High, Low, +OShot, -OShot, Freq, Period, Rise, Fall, +Width, -Width, Duty, Burst1, Burst2, Pulse, AvgFreq, AvgPeriod, Int1TY, Int2TY, Int1XY, Int2XY, Delay (between channels)
- The following statistical processes can also be performed. Covered parameters: Those listed above.
- Statistic types: Min, Max, Ave, Cnt, Sdv
- Statistic modes: Normal, Cycle, History

Mathematical functions:	Addition, subtraction, multiplication, binary conversion, inversion, differentiation, integration, power spectrum (FFT)

User-defined calculations (optional):
- Equations can be set based on user-defined combinations of operators.
- Addition, subtraction, multiplication, division, ABS, SQR, LOG, EXP, NEG, SIN, COS, TAN, ATAN, PH, DIF, INTG, BIN, P2, P3, F1, F2, FV, PWHH, PWHL, PWLH, PWLL, PWXX, DUTYH, DUTYL, FILT1, FILT2, HLBT, MEAN, MAG, LOGMAG, PHASE, REAL, IMAG
- FFT types: LS, PS, PSD, CS, TF, CH

GO/NO-GO judgment:	Evaluation based on automatically measured waveform parameter values and waveform zones

● Screen data output

Built-in printer (optional):	Paper width: 112 mm
	Output formats: Normal, Long

External printers:	Output to external printers through the USB peripheral port or Ethernet port.
	Supported printer commands: ESC/P, ESC/P2, LIPS3, PCL5, BJ, PostScript (through Ethernet only)
Floppy disk/Zip®/SCSI/Network drive/PC card:	
	Output formats: PostScript, TIFF, BMP, JPEG, PNG

Power Analysis Functions (optional)

Correction of the difference in the electrical lengths of the probes (Deskew)

Corrects (deskew) the difference in the electrical length of voltage and current signals automatically or manually The correction range is ±100 ns (0.01 ns resolution).

Automated measurement of power analysis parameters:

As with the standard measurement parameters (waveform parameters), performs automated measurement of power analysis parameters (see below). Automated measurement on dual areas is also possible.

Voltage:	Amplitude UP-P, maximum value U+pk, minimum value U-pk, DC component Udc, rms value Urms, AC component Uac, rectified mean value calibrated to the rms value Umn, and rectified mean value Urmn
Current:	Amplitude IP-P, maximum value I+pk, minimum value I-pk, DC component Idc, rms value Irms, AC component Iac, rectified mean value calibrated to the rms value Imn, and rectified mean value Irmn
Power:	Apparent power S, active power P, and reactive power Q
Power factor:	Power factor I of the circuit under measurement
Impedance:	Impedance Z of the circuit under measurement
Watt hour:	Sum of positive and negative watt hours Wp, sum of positive watt hours Wp+, and sum of negative watt hours Wp-
Ampere hour:	Sum of positive and negative ampere hours q, sum of positive ampere hours q+, and sum of negative ampere hours q-
Heat energy:	Joule integral I²t
Statistical processing on the measured values:	As with the standard measurement parameters, performs statistical processing on the measured values of power analysis parameters.
Waveform computation on power analysis parameters:	As with the standard waveform computation, performs waveform computation such as Instantaneous power, impedance, Joule integral, power spectrum, and harmonics For waveform computation of harmonics, simple comparison against the limits of IEC 61000-3-2 Edition 2.1, and EN61000-3-2 Amendment 14 is possible.
Trend display:	Displays the trend of the change in the measured values of waveform parameters per cycle over time
History search:	As with the standard measurement parameters, performs history search using power analysis parameters.
GO/NO-GO determination:	As with the standard measurement parameters, performs GO/NO-GO determination using power analysis parameters.
Saving of the computed results of harmonics:	Saves the computed result of harmonics to a file in CSV format

I²C bus analysis functions (optional)

● Applicable Bus

I²C bus:	Bus transfer rate: Up to 3.4 Mbits/s
	Address mode: 7 bits
SM bus	Conforms to the System Management Bus.

● Trigger Function

Trigger source:	CH1: SCL
	CH2: SDA
	CH3 to CH8(CH4[3]): Analog signal input
Start/Stop conditions for I²C bus signal trigger:	Select the start/stop conditions from the following:

- Ignore/Not ignore restart conditions
- Ignore/Not ignore start/stop conditions that do not conform to the protocol

I²C bus signal trigger	Select from the following two trigger types.
• Address&Data:	Activates the trigger based on the comparison of the specified address and data
• Non-Ack:	Activates a trigger when an acknowledge is not present.

For Address&Data trigger, a trigger is activated on the combination (AND logic) of the five items below. Address, Data 1 and Data 2 can be enabled or disabled.

• Start Condition	Activates a trigger on the start condition.
• Address	Activates a trigger on the true/false condition of the result of the comparison with the address
• Data 1	Activates a trigger on the true/false condition of the result of the comparison with the data immediately after the address.
• Byte Count	Activates a trigger at the specified number of bytes after the start condition. The selectable range is 0 or 9999.
• Data 2	Activates a trigger on the true/false condition of the result of the comparison with the data that is present after the byte count passes.
Combination trigger:	Possible to activate triggers by combining the CH3 to CH8(CH4[3]) analog signals and the I²C bus signal (CH1 and CH2).
• I²C on Pattern	Activates a trigger when the trigger conditions of the I²C bus are met on the true or false condition of the CH3 to CH8(CH4[3]) parallel pattern.
• I²C -> Pattern	Activates a trigger when the pattern trigger condition is met after the trigger condition of the I2C bus signal is met.

● Analysis Function

Signal input:	Select CH1 (SCL), CH2 (SDA) or CH3 (SCL), CH4 (SDA).
Number of data points that can be analyzed	
	Up to 40,000 bytes

Display of the analysis results

Displays the analysis results using the following two methods.

- Waveform and the list of analysis results
  Simultaneously displays the waveform and the list of analysis results
- List of detailed analysis results
  Displays No., Time, Binary, Hex, and Ack.

● Search Function

Data search:	The following two types of search are possible.

- Pattern search (Byte Pattern)
  Set the address pattern, data pattern, and Acknowledge bit condition and search the waveform.
- Indefinite data search (Indefinite State)
  Indefinite data can be searched.

● Analysis Result Save Function

Data storage of the list of detailed analysis results:	Saves the list of detailed analysis results to a file in ASCII format.

CAN Bus Signal Analysis Function (optional)

● Supported CAN Bus

CAN Bus:	CAN Version 2.0B
Bit rate:	Set any of the following bit rates: 1 M, 500 k, 250 k, 125 k, 100 k, 95.238 k, 83.333 k, 62.5k, 50 k, 33.333 k, 20k, 10k [bps] or an arbitrary bit rate between 1 M to 10 k [bps] (The resolution is the bit time (reciprocal of the bit rate of 0.5 us). Supports High speed CAN(ISO11898) and Low speed CAN(ISO11519-2)

● Trigger Function

Trigger source:	CH1: CAN bus signal (Input CAN_H and CAN_L signals via differential probes.)
	CH2 to CH8(CH4[3]): Analog signal input
CAN bus signal trigger:	Activates a trigger on the combination (AND logic) of the five items below.
• Start of Frame	Activates a trigger on the Start of Frame (SOF).
• Identifier	Activates a trigger on the Identifier that matches the specified conditions.
• RTR	Activates a trigger on a remote frame (RTR is recessive).
• Data Field	Activates a trigger at the data field that matches the specified conditions (up to 8 bytes can be specified).
• Error Frame	Activates a trigger on an error frame.
Combination trigger:	Possible to activate triggers by combining the CH2 to CH8(CH4[3]) analog signals and the CAN bus signal (CH1).
• CAN on Pattern	Activates a trigger when the CAN trigger conditions are met on the true or false condition of the CH2 to CH8(CH4[3]) parallel pattern.
• CAN -> Pattern	Activates a trigger when the pattern trigger condition is met after the trigger condition of the CAN bus signal is met.

● Analysis Function

Signal input:	Select CH1 or CH3.
Number of frames that can be analyzed:	Up to 16,000 frames
Frames that are analyzed:	Three types: Remote Frame, Data Frame, and Identifier.
Display of the analysis results:	Displays the analysis results using the following two methods.

- Waveform and the list of analysis results
  Simultaneously displays the waveform and the list of analysis results.
- List of detailed analysis results
  Displays No., Time, ID, Data, CRC, ACK and Info. (error type).

Stuff bit computation	Extracts stuff bits from the CAN Bus waveform and displays them as a Math waveform (Math1).

● Search Function:

Data search:	The following two types of search are possible.

- Pattern search (Frame Pattern)
  Search the waveform by specifying a field or frame pattern.
- Indefinite data search (Indefinite State)
  Indefinite data can be searched.

Field jump	Moves the zoom position (Z1 Pos) to the beginning of a certain field within the current frame.

● Analysis Result Save Function

Data storage of the list of detailed analysis results:	Saves the list of detailed analysis results to a file in ASCII format.

SPI Bus Signal Analysis Function (optional)

● Trigger Function

Trigger source:	CH1: SCK
	CH2: MOSI
	CH3: MISO
	CH4: SS
	CH5 to CH8: Analog signal input (only for the DL7480)
SPI bus signal trigger:	Activates a trigger on the combination (AND logic) of the following four items. A Pattern and B Pattern can be enabled or disabled.
• Assertion of SS	Activates a trigger on the assertion of SS.
• A Pattern	Activates a trigger on true/false condition of the result of the comparison with the MOSI data immediately after the assertion of SS. The length of data that is compared can be set to 1 or 8 bytes.
• Byte Count	Activates a trigger the specified bytes after the assertion of SS (after the A pattern if A Pattern is enabled). The selectable range is 0 or 1,000.
• B Pattern	Activates a trigger on the true/false condition of the result of the comparison with the data that is present after the byte count passes.The data to be compared is selectable between MOSI and MISO.The data length can be set to 1 to 8 bytes.
Combination trigger: (available DL7480 only)	Possible to activate triggers by combining CH5 to CH8 analog signals and the SPI bus signal (CH1 to CH4).
• SPI on Pattern	Activates a trigger when the trigger conditions of the SPI bus signal are met on the true or false condition of the CH5 to CH8 parallel pattern.
• SPI -> Pattern	Activates a trigger when the pattern trigger condition is met after the trigger condition of the SPI bus signal is met.

● Analysis Function

Signal input:	CH1: Clock signal (SCK)
	CH2: Data 1 (MOSI)
	CH3: Data 2 (MISO)
	CH4 to CH8[3] or logic input: CS signal (SS)
Number of data points that can be analyzed:	Up to 80,000 bytes
Analysis Result Display:	Displays the analysis results using the following two methods.

- Waveform and the list of analysis results
  Simultaneously displays the waveform and the list of analysis results.
- List of detailed analysis results
  Displays No., Time, Dt1, Dt2, CS.

● Search Function

Data search:	The following two types of search are possible.

- Pattern search (Frame Pattern)
  Search the waveform by specifying a data pattern.
- Indefinite data search (Indefinite State)
  Indefinite data can be searched.

● Analysis Result Save Function

Data storage of the list of detailed analysis results:	Saves the list of detailed analysis results to a file in ASCII format .

Rear Panel I/O

Interfaces:	GP-IB, USB-PC connector, USB peripheral connector, Ethernet (100BASE-TX, 10BASE-T; optional), SCSI (optional)
Signal I/O:	One for external trigger input/external clock input/trigger gate input, one trigger output, one RGB video signal output (VGA)
Logic input:	Measured with 701981 logic probe (8 bits). Number of inputs: 16 bits (using two logic probes)

Logic probe (sold separately)
Number of inputs:	8
Maximum foggle frequency:	250 MHz (701981), 100 MHz (701980)
Input voltage range:	±10 V (DC + AC peak, 701981), ±40 V (DC + AC peak, 701980)
Probe power connectors:	Output connectors: 4 (an additional 4 are available as an option with 701470 and 701480)
Output voltage:	±12 V

General Specifications

Rated supply voltage:	100–120 VAC/220–240 VAC (switches automatically)
Rated supply frequency:	50/60 Hz
Maximum power consumption:	320 VA
External dimensions:	373 mm (W) × 210.5 mm (H) × 355.3 mm (D) (when the printer cover is closed; does not include knobs and protrusions)
Weight:	Approximately 10 kg (24.2 lbs, including printer; does not include logic inputs)

Dimensions (Models 701450, 701460, 701470, and 701480)

Unit: mm (inch)

374 (14.72)
373 (14.69)
14 (0.55)
210.5 (8.29)
20 (0.79)
40 (1.57)
349.6 (13.76)
31 (1.22)
324.3 (12.77)

1: Measurements are obtained following calibration with the internal clock as the time base after the warmup period under the reference operating conditions (see below).
Reference operating conditions
Ambient temperature: 23 ± 2°C
Ambient humidity: 55 ± 10% RH
Supply voltage/frequency tolerance: Within 1% of rating
2: When interleave mode is on, the number of available channels is half the installed number of channels.
3: CH4 on the DL7440, CH8 on the DL7480
4: When using Miniature passive probe model 701941; specified at probe tip:

Visit our homepage at http://www.yokogawa.com/tm/DL7400/

Model and Suffix Codes

Model	Suffix Code	Description
701450		DL7440 digital oscilloscope with 4 CH input and maximum 4 MW memory
701460		DL7440 digital oscilloscope with 4 CH input and maximum 16 MW memory
701470		DL7480 digital oscilloscope with 8 CH input and maximum 4 MW memory
701480		DL7480 digital oscilloscope with 8 CH input and maximum 16 MW memory
Power cable	-D	UL and CSA standard
	-F	VDE standard
	-Q	BS standard
	-R	AS standard
	-H	GB standard
Internal storage drive	-J1	Floppy disk drive[1]
	-J2	Zip® drive[1]
Options	/B5	built-in printer
	/E4	Four additional passive probes(701470, 701480 only)[2]
	/EX4	Attach four 701941 probes[7,9]
	/EA4	Four additional 701941 probes[8,9]
	/P4	Four additional probe power connectors(701470, 701480 only)[3]
	/N3	Logic input for 701450/701470[4]
	/N4	Logic input for 701460/701480[4]
	/C7	SCSI interface
	/C10	Ethernet interface
	/G2	User-defined math function[5]
	/G4	Power Supply Analysis Function[5]
	/F5	I2C + SPI Bus Analyzer[6]
	/F7	CAN + SPI Bus Analyzer[6]
	/F8	I2C + CAN + SIP Bus Analyzer[6]

1: Select one only.
2: The DL7400 Series is standard-equipped with four passive probes (700988).
3: The DL7400 Series is standard-equipped with four probe power connectors.
4: Select /N3 for models 701450 and 701470, and /N4 for models 701460 and 701480. Logic probes are sold separately. Purchase logic probe model 701981 (shown below under "Accessories (Optional)").
5: /G2 and /G4 cannot be specified together.
6: Option /F5, /F7, and /F8 cannot be specified together. Select one only. The SPI Bus Analysis and Search functions are Standard feature. The SPI Bus Triggers are available only as an option.
7: Four 700988 probes are not included when this option is specified.
8: This option can be specified with model 701470, 701480 only.
9: When the option /E4 is specified, neither /EX4 nor /EA4 can be specified together.

Standard Accessories

Name	Q'ty
Power cable	1
Passive probes (700988)	4
Printer roll paper (when option /B5 is specified)	1
User's manual (one set)	1
Front cover (transparent)	1
Soft carrying case (for probes, etc.)	1

Accessories (Optional)

Name	Model	Specifications
Passive probe	700988	10 MΩ (10:1), 400 MHz, 1.5 meters (one per unit)
FET probe	700939	900 MHz band
Logic probe (for DL7400)	701980	1 MΩ/10pF, 100 MHz toggle frequency
Logic probe (for DL7400)	701981	10 kΩ/9pF, 250 MHz toggle frequency
100:1 probe	700978	100 MHz band
Differential probe	700925	DC to 15 MHz band
Differential probe	700924	DC to 100 MHz band
Differential probe	701920	DC to 500 MHz band
Differential probe	701921	DC to 100 MHz band
Differential probe	701922	DC to 200 MHz band
Current probe	701933	DC to 50 MHz band, 30 Arms
Current probe	701930	DC to 10 MHz band, 150 Arms
Current probe	701931	DC to 2 MHz band, 500 Arms
Deskew Signal Source	701935	For /G4 option
Miniature passive probe	701941	DC–500MHz band
Rack mount kit	701965	for EIA rack

Note: See the Bulletin 7009-63E(DL series accessories) for details.

Supplies

Name	Part number	Description	Order Q'ty
Printer roll paper	B9850NX	30 meter roll (1 roll per package)	5
Passive probe	700988	10 MΩ (10:1), 400 MHz band,1.5 m (1 probe per package)	1
Front panel protective cover	B8051DP	A transparent cover	1

Related Products

Digital Oscilloscope DL9000 Series *signalXplorer*

Digital Oscilloscope DL1700E Series *SignalExplorer*

Digital Oscilloscope DL1600 Series *SignalExplorer*

ScopeCorders DL750/DL750P *ScopeCorder*

┌─ NOTICE ─
● Before operating the product, read the user's manual thoroughly for proper and safe operation.
● If this product is for use with a system requiring safeguards that directly involve personnel safety, please contact the Yokogawa sales offices.

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● Yokogawa's electrical products are developed and produced in facilities that have received ISO14001 approval.
● In order to protect the global environment, Yokogawa's electrical products are designed in accordance with Yokogawa's Environmentally Friendly Product Design Guidelines and Product Design Assessment Criteria.

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