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Harmonas-DEO™

PLC Integration Controller (DOPL™ II S)
(HD-DGB40*)

1. Introduction

DOPL II S is the PLC integration controller for the Harmonas-DEO™ system and Advanced-PS™ system. DOPL II S is used for connecting (Mitsubishi) MELSEC and GOT1000 nodes as I/O devices of DOPL II S via the MELSECNET (10 or H) network in order to achieve highcapacity, high-speed interface connections with B and W MELSECNET link devices. In addition, by making DOPL II S main units redundant, reliability of communication I/O with MELSEC devices and integrated control over MELSEC devices can be significantly improved.

While the primary role of DOPL II S is to integrate the PLC subsystems used to monitor and control the peripheral machinery of plants that need to be monitored and controlled by Harmonas-DEO systems and Advanced-PS systems, further advanced plant automation can be achieved by combining PLC and DCS functions.

Figure 1. PLC Integration Controller (DOPL™ II S)

DOPL II S has the following features.

High Reliability
High reliability is achieved not only by using highly reliable components, such as ECC memory (with automatic bit error correction functions), and by eliminating parts with a limited service life such as cooling fans, but also by control LAN redundancy and redundant architecture for the DOPL II S modules.

Three MELSECNET Modes
DOPL II S supports three communication operation modes: MELSECNET/10, MELSECNET/H, and MELSECNET/H extended mode. Modes are changed by changing the DOPL II S settings in the connected MELSECNET system. When the MELSECNET/H extended mode is used, the number of analog outputs can be doubled.

High-Speed, High-Capacity PLC Data Interface
Up to 63 MELSEC units can be connected to a DOPL II S node.
Data is transferred between DOPL II S and MELSEC by a high-speed, high-capacity fixed-cycle data link. Thus, DOPL II S's I/O processing is equivalent to that of a hard-wired connection. In particular, all the output processes from DOPL II S to MELSEC are completed in a single transmission so that output synchronization is maintained. With DOPL II S, either the MELSECNET/H or MELSECNET/10 mode can be selected.

Connected to GOT1000 series
MELSECNET-compatible GOT1000 can be connected to DOPL II S directly via MELSECNET.

Advanced Control Functions
DOPL II S has a full suite of process controller functions, including regulatory control, logic control, and sequence control functions, just like a DOPC series process controller. Control operations can be performed with cycle times as fast as 100 ms.
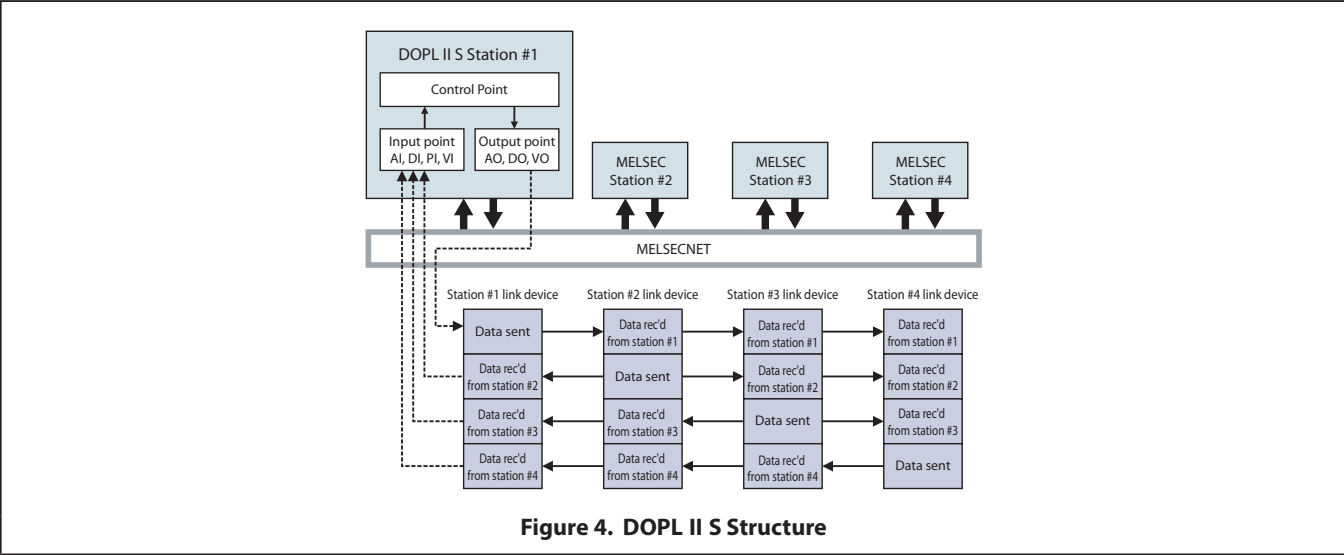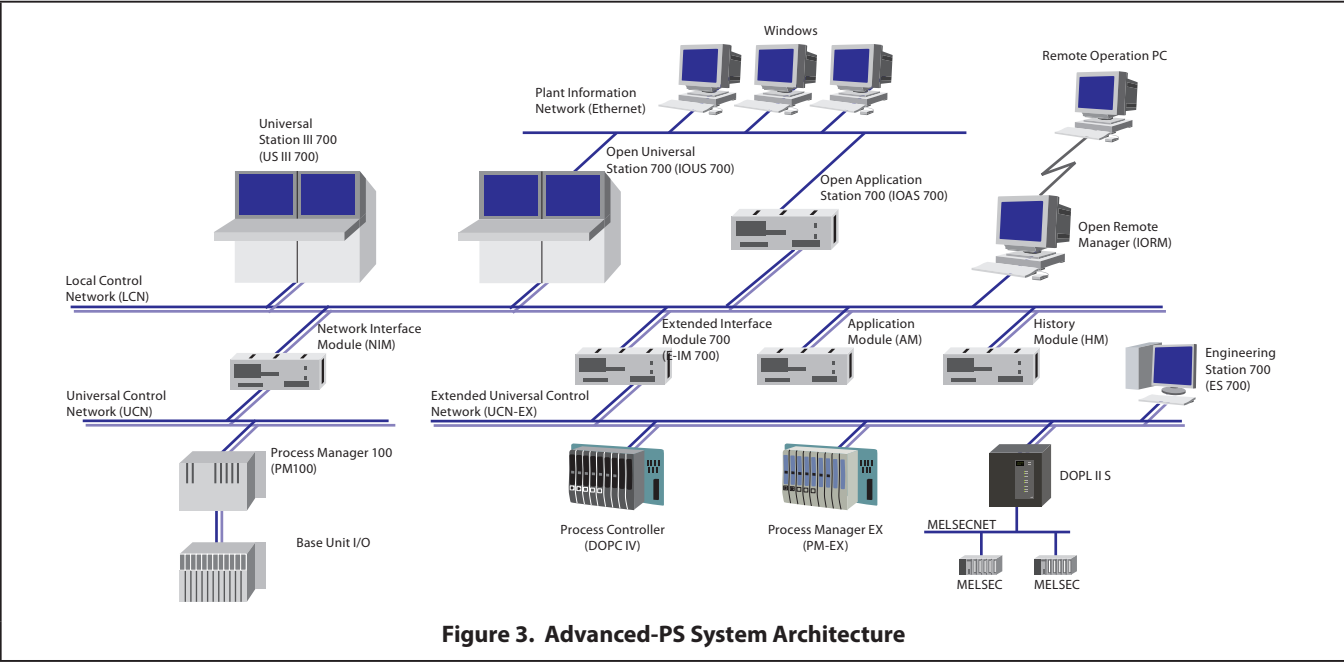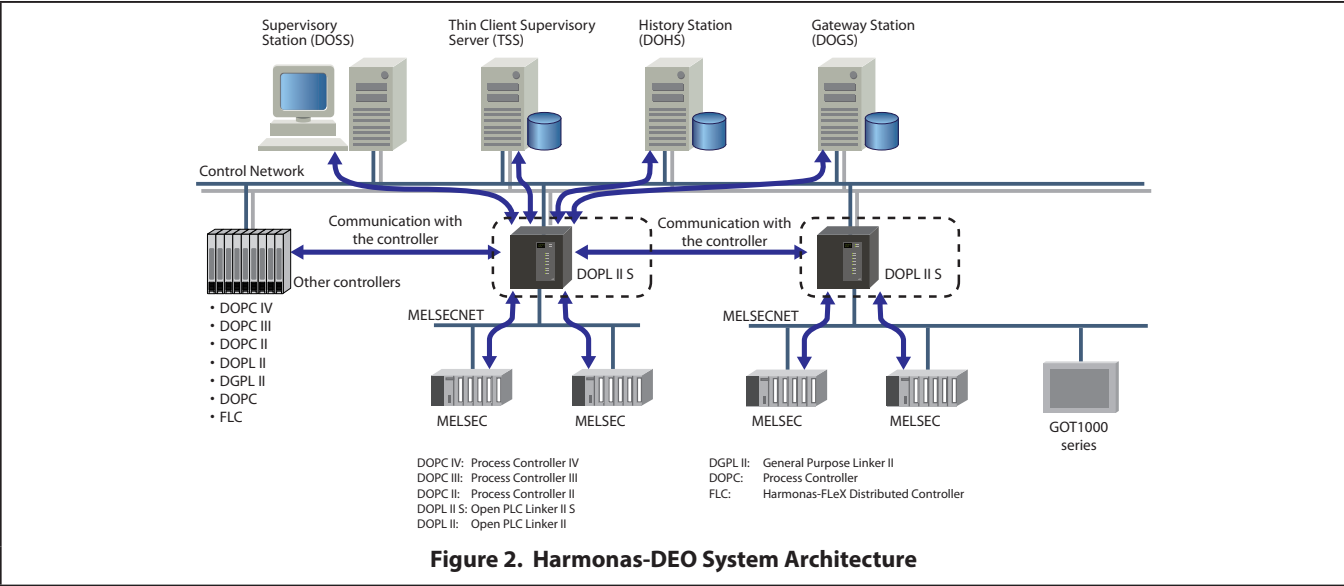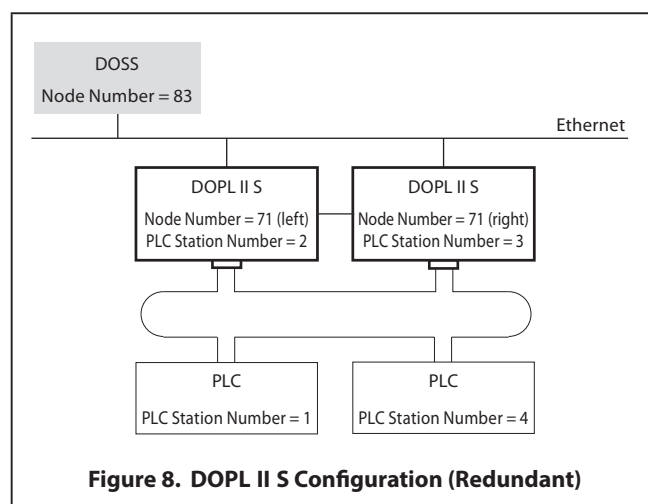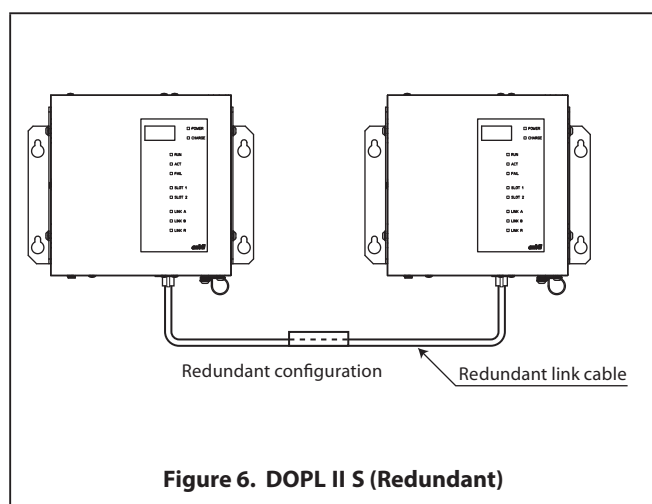
Integrated Engineering Environment
As with DOPC series, the integrated RTC development environment is used for software design, production, and debugging operations. Using the virtual controller function, a virtual DOPL II S node can be created within an HMI node, eliminating the need to use an actual controller when debugging.

2. System Architecture

DOPL II S can communicate with the supervisory station, other controllers (DOPC IV, DOPC III, DOPC II, DOPC, DGPL II, DOPL II, DOPL and FLC), and other application nodes (DOHS™, DOGS, etc.) via the Harmonas-DEO and Advanced-PS system control network. DOPL II S can read/write up to 10000 parameters per second with these nodes.

Figure 2. Harmonas-DEO System Architecture

Figure 3. Advanced-PS System Architecture

Figure 4. DOPL II S Structure

Figure 5. DOPL II S (Non-Redundant)

Figure 7. DOPL II S Configuration (Non-Redundant)

Figure 6. DOPL II S (Redundant)

Figure 8. DOPL II S Configuration (Redundant)
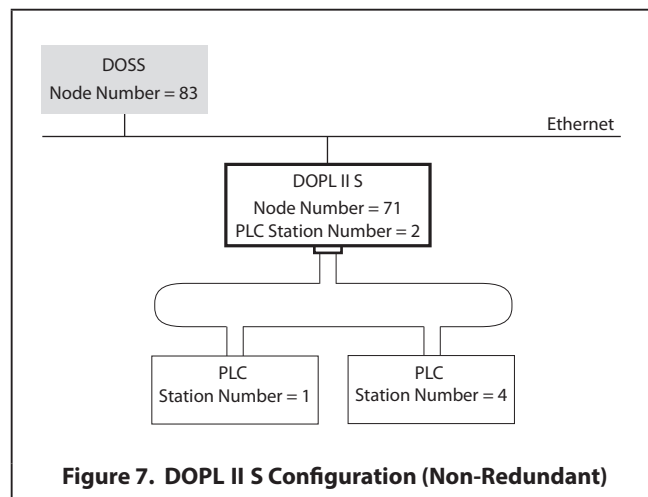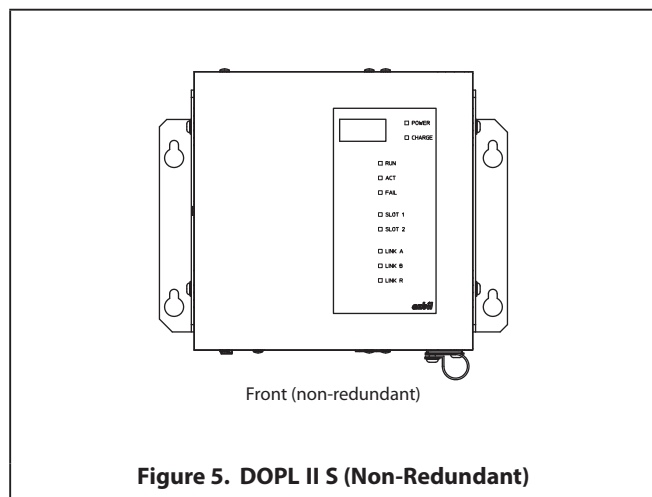
3. MELSECNET Connection Specifications

Compatible networks

MELSECNET/H (optical SI/QSI cable)
MELSECNET/10 (optical SI/QSI cable)

Number of devices connected to MELSEC

Redundant DOPL II S: 62 max.
Non-redundant DOPL II S: 63 max.

Connectable MELSECNET units

Q series: QJ71LP21-25, QJ71LP21S-25
A series: AJ71LP21
AnS series: A1SJ71LP21
QnA series: AJ71QLP21, AJ71QLP21S
QnAS series: A1SJ71QLP21, A1SJ71QLP21S
iQ-R series: RJ71LP21-25

Connecting with GOT1000

The GT15-J71LP23-25 MELSECNET/H optical loop unit is necessary.
Communication with DOPL II S is limited to LB and LW link communication.

4. Overview of I/O Processing and Control Functions

The DOPL II S I/O subsystem consists of the MELSECNET10 or MELSECNET/H network (hereafter referred to as MELSECNET), which is directly connected to DOPL II S. Highspeed, high-capacity data exchange between DOPL II S and MELSEC nodes connected to MELSECNET is accomplished via the B and W link devices. DOPL II S provides various control functions in order to fulfill a broad spectrum of process automation and electro-mechanical plant automation requirements, in combination with MELSEC. Using DOPL II S, you can easily implement various I/O processes, regulatory controls, logic controls, and more advanced control functions.

4.1. I/O Points

The I/O points of a DOPL II S node are the data input/output points defined between DOPL II S and MELSECNET. These I/O points are mapped to the associated (B and W) MELSECNET link devices. Input signals to I/O points are transferred to other control points, such as those within DOPL II S, to be used for relevant control processes. Output signals from control points can be transferred to MELSECNET via I/O points. Each of the points can be configured to enable specific functions of the point that are unique to each point type.

Analog Input Point (AI)

Analog output I/O points convert 32-bit floating point (4-byte real number) outputs (OP in a range of 0–100 %) or extended outputs (OP_EXT in a user-specified range) to 16-bit (2-byte) signed integers, and then output them as W device values to MELSECNET.
Example AI point functions are listed below:
- PV source selection (auto, manual, and substitution)
- PV clamp
- Engineering unit conversion
- PV value status
- PV filter
- PV alarm
- Input range (W device)
   0 to 100, 0 to 999, 0 to 1023, 0 to 2000, 0 to 4000, 0 to 4095,
   0 to 5000, 0 to 8000, 0 to 9999, 0 to 12000, -2000 to 2000,
   -4000 to 4000, -4095 to 4095, -6000 to 6000, -8000 to 8000,
   -12000 to 12000 0 to 1000, 0 to 10000, 0 to 16000,
   0 to 24000, 0 to 32000, 0 to 32767, -1000 to 1000,
   -10000 to 10000, -16000 to 16000, -24000 to 24000,
   -32000 to 32000, -32768 to 32767 , user-specified

Analog Output Point (AO)

Analog output I/O points convert 32-bit floating point (4-byte real number) outputs (OP in a range of 0–100 %) or extended outputs (OP_EXT in a user-specified range) to 16-bit (2-byte) signed integers, and then output them as W device values to MELSECNET.
Example AO point functions are listed below:
- Linearization of output signal (five segments)
- Output range (W device)
   0 to 100, 0 to 999, 0 to 1023, 0 to 2000, 0 to 4000, 0 to 4095,
   0 to 5000, 0 to 8000, 0 to 9999, 0 to 12000, -2000 to 2000,
   -4000 to 4000, -4095 to 4095, -6000 to 6000, -8000 to 8000,
   -12000 to 12000 0 to 1000, 0 to 10000, 0 to 16000,
   0 to 24000, 0 to 32000, 0 to 32767, -1000 to 1000,
   -10000 to 10000, -16000 to 16000, -24000 to 24000,
   -32000 to 32000, -32768 to 32767 , user-specified

Digital Input Point (DI)

Digital input I/O points accept B device digital (ON/OFF) data and convert the data to digital input variables that can be handled by DOPL II S.
Example DI point functions are listed below:
- Status input (ON/OFF status input)
- PV source selection (auto, manual, and substitution)
- Input reversal process (reversing the polarity of inputs)
- Status alarm
- Setting of alarm dead time

Digital Output Point (DO)

Digital output I/O points output digital (ON/OFF) variables from DOPL II S to MELSECNET as B device data. The following output types can be selected (configurable per point):
- Status output (ON/OFF status output)
- Latch output
- Momentary output

Pulse Input Point (PI)

Pulse input I/O points convert 32 bit (4 byte) signed integer values for the W device to 32 bit floating decimal point (4 byte real) values to be handled as pulse input variables by DOPL II S.
Example PI point functions are listed below:
- Instantaneous value calculation and engineering unit conversion
- PV source selection (auto, manual, and substitution)
- PV value status
- PV filter
- PV alarm

Value Input Point (VI)

Value input I/O points either accept 32 bit (4 byte) signed integer input values for 2 consecutive words of the W device as they are or convert them to 32 bit floating decimal point (4 byte real) value inputs to be handled by DOPL II S as analog input variables.

Value Output Point (VO)

Value output I/O points either output 32 bit (4 byte) signed integer output data as they are or convert 32 bit floating decimal point (4 byte real) output data to 32 bit signed integer data, i.e., 2 consecutive words of the W device value, for output to MELSECNET.

4.2. Control Functions (Control Points)

Control functions are classified into the following types of control point:

Regulatory PV Point (RegPV)

Regulatory PV points are used for process variable (PV) calculations and corrections. PV point processing uses algorithms such as flow rate correction, integration, and variable dead time compensation. In addition, the wide range of available functions include enhanced alarm check and suppression, signal filtering, and other options for calculation algorithms.

Table 1. Regulatory PV Point Features

RegPV Algorithms	Supported Functions
Data collection (DataAcq)	PV source selection (auto, manual, and substitution)
Flow compensation (FlowComp)	
Middle of three (MidOf3)	PV clamp
High/low/average selector (HiLoAvg)	Engineering unit conversion and PV extension range check
Summation (Summer)	PV status
Integration (Totalizr)	PV filtering
Variable dead time with lead/lag compensation (Vdtldlag)	PV alarm
	- Bad PV
General linearization (GneLin)	- Upper and lower limits of PV
Calculator algorithm (Calcultr)	- High-high/low-low PV limits

Regulatory Control Point (Reg Ctl)

Regulatory control points are used to carry out the control functions of DOPL II S. Configuration of the algorithms listed in Table 2 determines the regulatory control point functions. Each algorithm has configurable options, allowing complicated control to be achieved by simple menu selection. Standard functions include initialization and windup protection. Set point ramping (by operator entry of target values and ramp time) is also available.

Table 2. Regulatory Control Point Features

RegCtl Algorithms	Supported Functions
PID (Pid)	Mode/mode attribute
PID with feed forward (PidFf)	Red tag
PID with external feedback (PidErfb)	Initialization
Position proportional ON/OFF control (PosProp)	Windup protection
	External mode switching
Ratio control (RatioCtl)	Safety shutdown
Ramp soak (RampSoak)	Limit (output)
Automatic/manual station (AutoMan)	PV source selection (auto, manual, and substitution)
Incremental sum (IncrSum)	PV alarm
Switch (Switch)	- Bad PV
Override selector (ORSel)	- Upper and lower limits of PV - High-high/low-low PV limits

Digital Composite Point (Dig Comp)

Digital Composite points are multi-input and multi-output points that provide an interface to discrete equipment, like motors, pumps and solenoid valves. Digital Composite points provide interlock processing functions as a standard feature. Dig Comp points can also display interlock states on the screen of an open supervisory station. The displayed states have information effective for tracking the cause of the interlock. The local "hand/off/auto" switches generally used for motor driving equipment can also be handled. Figure 8 shows the major parameters related to this type of control point.
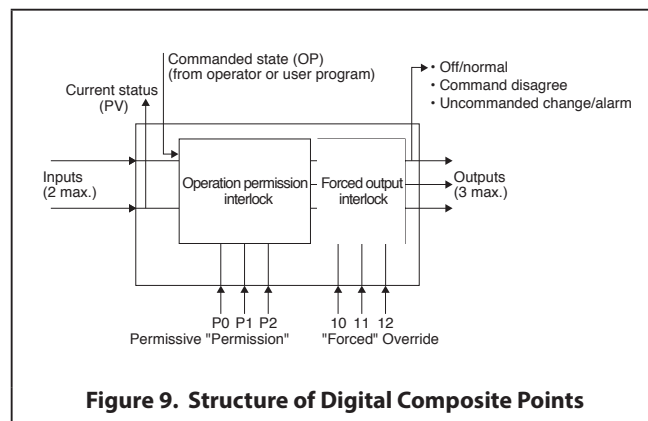

Figure 9. Structure of Digital Composite Points

Logic Point (Logic)

Logic points are used with digital composite points to provide interlock logic functions. Logic points provide processing functions equivalent to relay ladder logic processes. A logic point consists of a logic block, flag, numeric value variable, input connection and output connection. There are three possible configurations of logic point inputs, outputs, and logic blocks (see Table 3). In addition to offering logic block functions, logic points can also be used for data transfer. In this role they read data from input connections and transfer it via output connections to the parameters of other defined databases.

Table 3. Configuration Options for Logic Points

Type / Configuration	Max. Inputs	Max. Outputs	Max. Logic blocks
Option 1	12	4	16
Option 2	12	8	8
Option 3	12	12	0

Note: Each logic point provides six status flags, six user flags and four numeric value variables.

Table 4. Logic-Block Algorithms

Logic	AND OR NOT NAND NOR XOR QUALIFIED-OR2 (2-input agreement) QUALIFIED-OR3 (3-input agreement)
Comparison	EQ (= dead band) NE (≠ dead band) GT (> dead band) GE (≥ dead band) LT (< dead band) LE (≤ dead band)
Delay	DELAY ONDELAY OFFDELAY
Pulse	FIXPULSE (fixed length pulse) MAXPULSE (maximum time limit pulse) MINPULSE (minimum time limit pulse)
Watch dog timer	WATCHDOG
Flip flop	FLIPFLOP
Input error check	CHECKBAD
Switch	SWITCH
Change detection	CHDETECT

Note: The AND, OR, NAND, and NOR gates accept three inputs per block. Each of the inputs can be optionally reversed.

Function Block Point (FB)

A function block point consists of 91 different types of function blocks. A single point can use up to 8191 functions, and a single node up to 16383 function blocks. Function blocks conform to the SAMA (Scientific Apparatus Makers Association) block notation system. The user arranges function blocks in a logic diagram to construct control functions.

Table 5. Function Block Algorithms

Arithmetic operation (8 types)	ADD (addition)	SUB (subtraction)	MUL (multiplication)	DIV (division)
	MOD (modulo)	EXPT (exponent xy)	SUM (4-point addition)	DADD (digital addition)
Single number value variable (13 types)	ABS (absolute value)	SQR (square)	SQRT (square root)	LN (logarithm natural)
	LOG (customary logarithm)	EXP (exponent ex)	SIN (sine)	COS (cosine)
	TAN (tangent)	ATAN (arctangent)	TRUNC (truncation)	ROUND (rounding)
	PSQRT (percent square root)			
Selection (9 types)	MAX (maximum value)	MIN (minimum value)	AVG (average value)	
	HSE (high selector)	LSE (low selector)	MID3 (middle of three)	
	SW (switch)	SFT (softening switch)	ALSW (alternate switch)	
Detection (12 types)	HLM (high limiter)	LLM (low limiter)	DRL (rate-of-change limiter)	HMS (high monitor)
	LMS (low monitor)	DRM (rate-of-change monitor)	DMS (deviation monitor)	NUMCHK (normality check)
	BADCHK (badness check)	INFCHK (infinity check)	QLTCHK (change check 1)	CHGCHK (change check 2)
Conversion (4 types)	PTE (EU value conversion)	ETP (% conversion)	FUNC (function conversion)	CONV (data type conversion)
Logical operation (11 types)	AND (logical product)	OR (logical sum)	NOT (inversion)	NAND (inverted logical product)
	NOR (inverted logical sum)	XOR (exclusive logical sum)	QOR2 (2-input majority decision)	SR (set)
	RS (reset)	ORIN4 (4-input logical sum)	ANDIN4 (4-input logical product)	
Comparison (6 types)	EQ (= with dead band)	NE (≠ with dead band)	GT (> with dead band)	
	GE (≥ with dead band)	LT (< with dead band)	LE (≤ dead band)	
Pulse (3 types)	FIXPLS (fixed length pulse)	MAXPLS (maximum time limit pulse)	MINPLS (minimum time limit pulse)	
Timer (5 types)	CYCPLS (timer)	WDT (watch dog timer)	DELAY (delay)	ONDLY (on delay)
	OFFDLY (off delay)			
Counter (4 types)	UCNT (up counter)	DCNT (down counter)	AAV (analog integration)	PAV (pulse integration)
Control operation (8 types)	PID (PID operation)	PRO (proportion)	INT (integration)	DIF (differentiation)
	LDLG (leading/delay)	DED (waste time)	TF (filtering time)	DLTPV (speed type PV)
Others (8 types)	RMP (lamp)	MAV (movement average)	ANMA (analog memory)	GW (gate way)
	SG (single)	FL (flag)	TIMFL (one shot FL)	REDTAG (read tag)

Process Module Data Point (Proc Mod)

Process control often requires flexible control programs that can be used for continuous, batch, or hybrid applications. A process module data point is a user-created program (CL program) written in a special-purpose control language. This language provides powerful sequence control and calculation functions. CL programs can access analog input and output, digital input and output, logic block status, alarm status, failure status, numeric value variables, and flags. Process module data points provide phase, step and statement structures suitable for implementing batch process control functions. They can also activate a sequence for hold, shutdown, or emergency shutdown, making use of the powerful functionality of multilevel error processing.

4.3. Internal Variable Point

Flag Point

Flag points indicate two states, such as on and off, and accept input of Boolean algebra values. Flag points can be changed by operators or user programs. DOPL II S allows up to 8192 flags, 2048 of which support off-normal alarms (a change from steady state generates the alarm).

Numeric Value Variable Point

Numeric value variable points are variables that save numeric values, which is especially useful for batch (recipe) operations. In DOPL II S, 8192 numeric value variable points are available.

Timer Variable Point

Timer points are used by both operators and user programs to supervise process events. Timer points are processed once every second. DOPL II S has 256 available timer variable points. They are processed once per second, thus allowing measurement of elapsed time up to 32000 seconds or 32000 minutes.

Individual timer variable points are provided with a function to display commands (such as Start, Stop, Reset, and Restart), the set value (SP), the current value (PV), the remaining time (SP - PV), etc.

5. Alarm System Functions

DOPL II S supports a variety of alarm functions. When a DOPL II S node detects an alarm, alarm event transmissions are made from the DOPL II S to the supervisory station, history station, etc., so that the alarm is seen on the screen displays and is heard and/or is recorded. Alarms are generally classified as PV alarms or digital alarms.

PV Alarm

The following PV alarms can be configured for process variables. Alarms are detected either in I/O points or in control points. In general, if the I/O point is connected to a control point, the alarms are set to be detected at the control point. If the I/O point is not connected to a control point, the alarms are set to be detected at the I/O point.
- PV high, PV high-high
- PV low, PV low-low
- PV rate-of-change high, PV rate-of-change low
- PV significant change
- Deviation high/low
- Forecast deviation
A dead band can be set for all the above PV alarms.

Digital Alarm

The following three types of digital alarm are available:
- Off-normal alarm (DigComp, DI, FL)
- Uncommanded change alarm (DigComp)
- Command disagree alarm (DigComp)
Off-normal alarms are generated when the PV is abnormal. Both uncommanded change alarms and command disagree alarms are set within digital composite points and detect a disagreement between input and output. While the command disagree alarm detects any disagreement between input and output immediately after an output change, the uncommanded change alarm detects any disagreement between input and output when no output change is being made. Both alarms can be set for dead band time.

Alarm Priority

Alarm priority can be configured for individual alarm types for each point. A choice of five alarm priorities can be assigned:
- Emergent (E: emergency)
- Important (H: high)
- Ordinary (L: low)
- Journal printout (printing and recording)
- Printout (printing only)
- Journal (record only)
- None (no action)

Contact Cutout

The contact cutout function allows a program to temporarily stop an alarm for each point having alarm functions. The CONTCUT parameter, which is available for points having alarm functions, can be turned on to put points in the alarm stop status.

6. Processing Performance

By combining adjustment control loops, logic functions, and sequence and I/O processes, DOPL II S tailors control functions to fit the needs of specific applications. Configuration needs to take into account restrictions on the maximum number of points per DOPC III, the processing unit (PU) value, which is a unit of processing capability, and the memory unit (MU) value, which is the permitted memory size for a CL program.

6.1. Maximum Number of Points

Limits on the number of points settable per DOPL II S are as follows.

Table 6. Maximum Number of Points Per DOPL II S

Category	Point Type (Abbreviation)	Number of Points	
		NET10 mode NET/H mode (See note 1 and 2)	NET/H extended mode (See note 1 and 3)
I/O point	Analog input (AI)	Up to 3840 points	Up to 3840 points
	Analog output (AO)	Up to 1000 points	Up to 2048 points
	Digital input (DI)	Up to 7680 points	Up to 7680 points
	Digital output (DO)	Up to 7680 points	Up to 7680 points
	Pulse input (PI)	Up to 1920 points	Up to 1920 points
	Value input (VI)	Up to 1920 points	Up to 1920 points
	Value output (VO)	Up to 500 points	Up to 1024 points
Control point	Digital composite (Dig-Comp)	Up to 1600 points	Up to 1600 points
	Logic (Logic)	Up to 480 points	Up to 480 points
	Process module (ProcMod)	Up to 512 points	Up to 512 points
	Regulatory PV (RegPV)	Up to 480 points	Up to 480 points
	Regulatory control (RegCtl)	Up to 640 points	Up to 640 points
	Function block (FB)	Up to 511 points	Up to 511 points
Internal variable point	Numeric variable (NN)	8192 points	8192 points
	Flag variable (FL)	8192 points	8192 points
	Timer variable (TM)	256 points	256 points

Note:
1. The number of I/O points should be within (AI points + AO points)/16+ (DI points + DO points)/32 + (PI points + VI points + VO points)/8 ≤ 240.
2. For the MELSECNET10 mode and MELSECNET/H mode, the condition that the number of AO points × 2 + the number of DO points/8 + the number of VO points × 4 ≤ 2000 must be satisfied.
3. For the MELSECNET/H extended mode the following conditions must be satisfied.
   • AO points + DO points + VO points ≤ 120 IOM
   • AO points × 2 + DO points/8 + VO points × 4 ≤ 4096

6.2. Processing Unit (PU Value)

This unit represents the processing capability of DOPL II S, based on factors such as the point types and control cycles. DOPL II S has a maximum PU limit. The sum of the PU values for DOPL II S must be within the limit. The following table lists the maximum PU values per DOPL II S for each point type.

Table 7. Maximum PU Value (per DOPL II S)

Point Type	Maximum PU
I/O point	1520
Control point	6000

Table 8. PU Maximums for Each Type of Point

Point Type		1 s PU Max.	500 ms PU Max.	200 ms PU Max.	100 ms PU Max.
I/O point	AI	0.77	1.54	3.85	7.70
	AO	0.07	0.14	0.35	0.70
	DI	0.14	0.28	0.70	1.4
	DO	0.07	0.14	0.35	0.7
	PI	0.77	1.54	3.85	7.70
	VI	0.03	0.06	0.15	0.30
	VO	0.02	0.04	0.10	0.20
Control point	DigComp	0.22	0.43	1.09	2.17
	Logic	1.48	2.96	7.40	14.80
	ProcMod (short)	1.00	-	-	10.00
	ProcMod (long)	2.00	-	-	20.00
	RegPV	0.70	1.39	3.48	6.96
	RegCtl	1.00	2.00	5.00	10.00

Table 9. PU Values for Function Blocks

Function Block	1 s PU Value	Function Block	1 s PU Value	Function Block	1 s PU Value
AND	0.022	MIN	0.031	LLM	0.018
OR	0.022	AVG	0.031	DRL	0.044
NOT	0.022	HSE	0.027	HMS	0.018
NAND	0.022	LSE	0.027	LMS	0.018
NOR	0.022	MID3	0.031	DRM	0.044
XOR	0.022	SW	0.027	DMS	0.027
QOR2	0.027	SFT	0.044	NUMCHK	0.018
SR	0.022	ALSW	0.022	BADCHK	0.018
RS	0.022	EQ	0.027	INFCHK	0.018
ABS	0.018	NE	0.027	QLTCHK	0.018
SQR	0.018	GT	0.027	CHGCHK	0.027
SQRT	0.018	GE	0.027	CYCPLS	0.031
LN	0.027	LT	0.027	WDT	0.027
LOG	0.027	LE	0.027	DELAY	0.018
EXP	0.027	PID	0.083	ONDLY	0.031
EXPT	0.027	PRO	0.027	OFFDLY	0.031
SIN	0.027	INT	0.053	PTE	0.022
COS	0.027	DIF	0.070	ETP	0.022
TAN	0.027	LDLG	0.044	FUNC	0.031
ATAN	0.027	DED	0.040	CONV	0.035
TRUNC	0.027	TF	0.053	SG	0.018
ROUND	0.027	UCNT	0.022	FL	0.018
ADD	0.027	DCNT	0.022	RMP	0.035
SUB	0.027	AAV	0.031	MAV	0.048
MUL	0.027	PAV	0.031	ANMA	0.031
DIV	0.027	FIXPLS	0.027	GW	0.022
MOD	0.022	MAXPLS	0.027	ADDIN4	0.031
SUM	0.031	MINPLS	0.027	ORIN4	0.031
DADD	0.031	TIMFL	0.031	REDTAG	0.009
DLTPV	0.027	PSQRT	0.018		
MAX	0.031	HLM	0.018		

Note: If the operation cycle is 500 ms, 200 ms, or 100 ms, multiply the PU values by 2, 5 or 10, respectively.

6.3. Memory Unit (MU Value)

The memory unit (MU) determines the size of the CL programs and indicates the allowable size of CL programs for a DOPL II S ProcMod point. A CL program unit consisting of 3 statements corresponds to one CL block, which is equivalent to one MU. The maximum MU value per DOPL II S is 48,000 MU.

6.4. Number of Blocks per Function Block Point

The following table shows the restrictions regarding the number of function blocks that constitute function block points:

Table 10. Maximum Number of Function Blocks

Number of blocks per FB point	8191 blocks
Number of blocks per DOPL II S	16383 blocks

6.5. Control Cycle

Control cycles are selectable per DOPL II S from among 1 s, 500 ms, 200 ms and 100 ms (for combinations, see Table 11). Not only the control cycles, but also some of the data points can be processed at high speed (100 ms) by means of the fast scan function.

Table 11. Combination of Basic Control Cycles

SCANRATE Parameter	Point Type				
	RegCTI, RegPV	Logic, DigComp	PromMod	FB	I/O Point
Reg1Log1	1 s	1 s	1 s	Selection of the following control cycles per point	Selection of the following control cycles per module
Reg1Log2	1 s	500 ms	1 s		
Reg1Log5	1 s	200 ms	1 s		
Reg1Log10	1 s	100 ms	1 s		
Reg2Log2	500 ms	500 ms	1 s	-1 s	-1 s
Reg2Log5	500 ms	200 ms	1 s	-500 ms	-500 ms
Reg2Log10	500 ms	100 ms	1 s	-200 ms	-200 ms
Reg5Log5	200 ms	200 ms	1 s	-100 ms	-100 ms
Reg5Log10	200 ms	100 ms	1 s		
Reg10Log10	100 ms	100 ms	1 s		
FastScan	100 ms	100 ms	100 ms		

6.6. Data Transfer Delay of MELSECNET

The approximate delay time for data transfer between DOPL II S and MELSEC can be calculated using the formulas below. I/O update transactions of DOPL II S should be completed within this time period (the actual time could be longer because this is not worst-case timing).

Transfer Delay in MELSECNET/H Mode

Transfer delay time TD (ms) = ST + αT + (LS×1) + (SR×2) + αR

ST: Scan time on the transmitting side (ladder operation cycle time)[*1]

SR: Scan time on the receiving side (ladder operation cycle time)[*2]

αT: Link refresh time on the transmitting side

αR: Link refresh time on the receiving side

LS: Link scan time

αT (ms) = 1.30 + 0.00067 × (LB1 + LW1×16) /16

αR (ms) = 1.30 + 0.00067 × (LB1 + LW1×16) /16

LB1: Total number of link relay LB points refreshed by the station

LW1: Total number of link register LW points refreshed by the station

LS (ms) at 10 Mbps =
  KB + 0.45 × Total no. of stations + (LB2+LW2×16) /8 × 0.001

LS (ms) at 25 Mbps =
  KB + 0.40 × Total no. of stations + (LB2+LW2×16) /8 × 0.0004

LB2: Total no. of link relay LB points of all stations in the network

LW2: Total no. of link register LW points of all stations in the network

KB: A constant (see table below)

Total no. of stations	2 to 8	9 to 16	17 to 24	25 to 32	33 to 40	41 to 48	49 to 56	57 to 64
KB	4.0	4.5	4.9	5.3	5.7	6.2	6.6	7.0

*1. If DOPL II S is on the transmitting side, ST = 1 ms
*2. If DOPL II S is on the receiving side, SR = 1 ms

Transfer Delay in MELSECNET/10 Mode

Transfer delay time TD (ms) = ST + αT + (LS×2) + (SR×2) + αR

ST: Scan time of the transmitting side (ladder operation cycle time)[*1]

SR: Scan time of the receiving side (ladder operation cycle time)[*2]

αT: Link refresh time of the transmitting side

αR: Link refresh time of the receiving side

LS : Link scan time

αT (ms) = 1.30 +0.00067 × (LB1 + LW1×16) /16

αR (ms) = 1.30 +0.00067 × (LB1 + LW1×16) /16

LB1: Total no. of link relay LB points refreshed by the station

LW1: Total no. of link register LW points refreshed by the station

LS (ms) = KB + 0.75 × Total no. of stations + (LB2+LW2×16) /8 × 0.001

LB2: Total no. of link relay LB points of all stations in the network

LW2: Total no. of link register LW points of all stations in the network

KB: A constant (see table below)

Total no. of stations	2 to 8	9 to 16	17 to 24	25 to 32	33 to 40	41 to 48	49 to 56	57 to 64
KB	4.0	4.5	4.9	5.3	5.7	6.2	6.6	7.0

*1. If DOPL II S is on the transmitting side, ST = 1 ms
*2. If DOPL II S is on the receiving side, SR = 1 ms

7. Smart Debug

Using the smart debug function, you can check the operation of various control functions and I/O processing functions of DOPL II S without the need for any I/O connections with MELSEC-NET. This can be done for any DOPL II S station. After transition to the debug mode, the function requires no I/O receive/transmit transactions with MELSECNET. Only control operations and I/O processing operations within DOPL II S are performed, so safe debugging can be accomplished.

The engineer can set any desired values on DOPL II S as simulated data in order to facilitate the debugging of CL programs, etc. Simulated input and output transactions are done with a supervisory station.

8. Virtual Debugging (Software Simulation)

The virtual debugging function is used for performing operational checks of DOPL II S without using actual devices. This function allows up to 4 DOPL II S systems to run virtually on a supervisory station. By using this function, operational functions can be verified not only with the control functions of DOPL II S, but also with inter-controller communication functions.

9. Auto Restart

DOPL II S restarts using predefined processes, without any operator intervention.

Cold Restart

A cold restart takes place as the first startup after system installation or database initialization. A database load is required for the startup to be performed. A cold restart requires that the DIP switch on the base unit be set to the ON position.

Warm Restart

The usual restarting method. This method is used for startup after power failures, which put DOPL II S into a sleep state. Warm restart is designed to minimize startup operation. Control loops that send output to field devices are put into manual mode. For the restart sequence, either automatic start, stop at the first step, or stop at the final execution position can be selected. This restart process requires that the DIP switch on the base unit be set to OFF. Additionally, the inputs of external terminals need to be set to OFF (open) status.

Hot Restart

Hot restart is for automatic recovery from a brief interruption. Process control restarts with the contents of the databases unchanged from their status just before the interruption. The databases are not reinitialized. Hot restart requires setting the DIP switch on the base unit to OFF, and requires the inputs of external terminals be turned ON (closed).

10. Self-Diagnostic Function

DOPL II S has self-diagnostic functions for detecting failures. Failures are classified into major or hard failures (HF) and minor or soft failures (SF). The DOPL II S status is indicated by the LED on the main unit and is displayed on the system status screen of the supervisory station.

Major failures (HF): Module failures, power supply failures, software errors, etc.

Minor failures (SF): Local line failures, DB synchronization line failures, I/O failures, etc.

11. Redundant Functions of DOPL II S

A redundant DOPL II S node (dual node) can be established using a pair of DOPL II S units in a standby redundancy configuration. If the primary module of a redundant DOPL II S node fails, switching to the secondary module is automatic. Although the node is in a dual node configuration using a pair of DOPL II S modules, the node is recognized as a single redundant node from the supervisory station or from any other nodes (it is unnecessary to define two sets of tags, etc.).

The primary and secondary DOPL II S modules constantly select a usable Ethernet communications path and synchronize the point database. The secondary side module constantly monitors the operation of the primary side module, and if any predefined error is detected, control rights are passed to the secondary side, which continues the control operation. The time required for switching the control rights is 500 ms.

Existing DOPL II and DOPL II S modules can be configured for redundancy. In this case, the existing primary/secondary decision ladder can be used.

On the other hand, if DOPL II S modules alone are configured for redundancy, the PLC's primary/secondary decision ladder can be omitted. In this case, the primary and secondary stations of the DOPL II S modules automatically switch between themselves.

Figure 10. Redundancy Configuration of DOPL II S
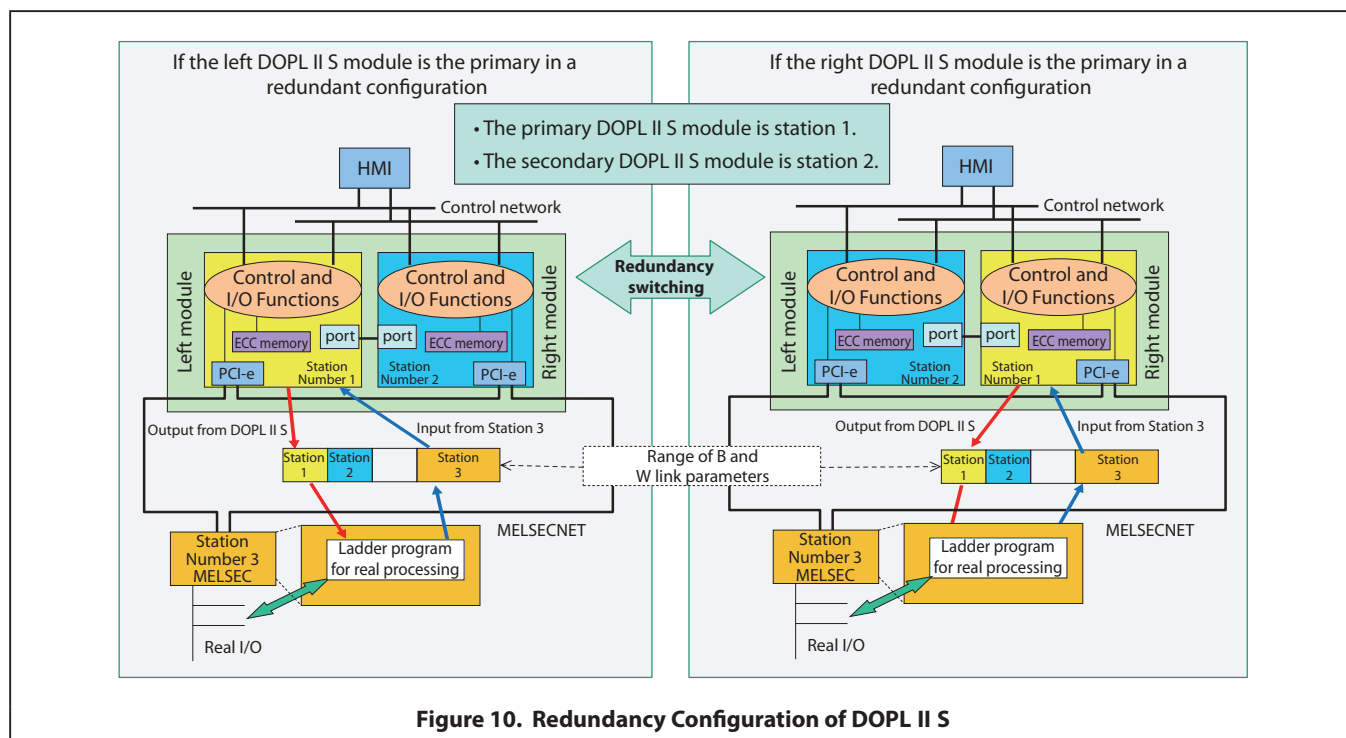
12. Installation Environment Conditions (cabinet mounting)

Table12. Installation Environment Conditions (cabinet mounting)

Item			Normal Operating Conditions	Operating Limit	Storage and Transport Conditions	Remarks
Ambient temperature (room temperature)	Range (°C)		5 to 35	5 to 35	-10 to +50	
	Rate of change (°C/h)		± 10	± 10	-	
Humidity			20 to 80% RH	20 to 80% RH	10 to 90% RH	Relative humidity at an absolute humidity of 0.028 kg/kg'
Power supply	Voltage variation	AC	± 10%	± 10%	-	
		DC	+10%, -15%	+10%, -15%	-	
	Peak value decrease		5% max.	5% max.	-	
	Frequency drift		± 2%	± 5%	-	
	Instantaneous power interruption	AC	10 ms max.	10 ms max.	-	
		DC	1 ms max.	1 ms max.	-	
	Ripple		1% max.	1% max.	-	
Vibration	Amplitude		0.75 mm max. (2 to 9 Hz)	0.75 mm max. (2 to 9 Hz)	1.5 mm max. (2 to 9 Hz)	
	Acceleration		2 m/s^2 max. (9 to 150 Hz)	2 m/s^2 max. (9 to 150 Hz)	5 m/s^2 max. (9 to 150 Hz)	
Electrostatic discharge			0 to 4 kV	0 to 4 kV	-	Contact discharge test
Radio frequency interference			0 to 3 V/m	0 to 3 V/m	-	

Note 1. The symbol (-) in the table indicates that no specifications are applicable for the item.
Note 2. Be sure to install and use DOPL II S in the control cabinet.

13. Specifications

Table13. Specifications for DOPL II S Main Unit

Item			Specifications	Remarks
Control network I/F			Fast Ethernet (2-channel) Automatically switches between 100 Mbps and 10 Mbps	RJ45 × 2 channels
MELSECNET interface I/F			1 channel (optical SI)	NET10, NET/H mode, selectable extended mode
Power supply	AC input	Supply voltage range	85 to 264 V AC	
		Power interruption detection time	100 ms min.	
		Frequency	50/60 ± 3 Hz	
	DC input	Supply voltage range	20 to 30 V DC	
		Power interruption detection time	100 ms min.	
Data backup function during a power interruption	Data backup time		4.5 seconds max.	
	Backup capacitor charging time		Approx. 5 minutes	
Power consumption			25 VA max.	In non-redundant configuration
Inrush current			100 V AC: 15 A max. 240 V AC: 30 A max. 24 V DC: 30 A max.	In non-redundant configuration
Grounding			Class D grounding	
Mass			Approx. 3.0 kg	

Note 1. Install this product in a cabinet in a factory, etc., and use it in industrial environments.
Note 2. Important notes for the use of this product under conditions compliant with UL-508A:
      (1) Use a 24 V DC model.
      (2) The 24 V DC power supply for this product must meet UL-1310 Class 2 standards.
      (3) If external contacts are used, the external power supply must also meet UL-1310 Class 2 standards.
      (4) Install this product in a cabinet compliant with UL-508A and NFPA79.

Table 14. Specifications for External Contact Output Signals

Item	Specifications
Recommended supply voltage	DC24V
Maximum supply voltage	DC30V
Maximum driving current	DC100mA
Contact output	Open collector, NC (normal closed)
External contact output operation	<table><tr><th colspan="2">DOPL II S operating status</th><th rowspan="2">External contact output</th></tr><tr><th>Power supply status</th><th>Operating status</th></tr><tr><td>Off</td><td>Stopped</td><td>Open</td></tr><tr><td>On</td><td>Before operation</td><td>Open</td></tr><tr><td>On</td><td>After operation</td><td>Closed</td></tr><tr><td>On</td><td>Stopped</td><td>Open</td></tr></table>
Block diagram for external contact output	
Example of an external circuit	Because the open collector mode is assumed, external devices such as relays and a 24V DC power supply need to be provided. ■ Example of an external circuit for non-redundant configuration of DOPL II S ■ Example of an external circuit for redundant configuration of DOPL II S

Table 15. MELSECNET Specifications

Item		MELSECNET/H Extended Mode	MELSECNET/H Mode	MELSECNET/10 Mode
Data rate		25 Mbps/10 Mbps	25 Mbps/10 Mbps	10 Mbps
Transmission line type		Dual optical loop	Dual optical loop	Dual optical loop
Maximum number of link points per network (LB and LW)		16384 (0 to 3FFF)	16384 (0 to 3FFF)	8192 (0 to 1FFF)
Maximum number of link points per station (transmit points)		LB/8 + 2 LW ≤ 35840 bytes	LB/8 + 2 LW ≤ 2000 bytes	LB/8 + 2 LW ≤ 2000 bytes
Number of connecting stations		64 stations (total of DOPLII and MELSEC stations)		
Transmission type		Token ring		
Synchronization method		Frame sync		
Coding method		NRZI code (Non-Return to Zero Inverted)		
Transmission format		Compliant with HDLC (frame format)		
Error control system		Retry by CRC and overtime		
RAS function		- Loopback function turns on upon error detection or cable breakage		
		- Prevention of a system crash by switching to the MELSECNET Administration Bureau		
Communication cable		SI (recommended), H-PCF, broadband H-PCF, QSI		
Total line length		30 km		
Distance between stations	With 25 Mbps mode:	SI: 200 m H-PCF: 400 m Broadband H-PCF: 1 km QSI: 1 km		
	With 10 Mbps mode:	SI: 500 m H-PCF: 1 km Broadband H-PCF: 1 km QSI: 1 km		

14. Model Number

DOPL II S Software License

Model No.	Name	Remarks
HD-SWPL2S0R	Basic software license for dual DOPL II S	
HD-SWPL2S0S	Basic software license for single DOPL II S	
HD-SWPL2S0U	Basic software upgrade license from DOPL II /PL-EX to DOPL II S	

DOPL II S Main Unit

Model No.	Name	Supplied items
HD-PLBS400R	DOPL II S redundant units (100 to 240V AC)	Redundant link cable × 1
HD-PLBS400RC	DOPL II S redundant units (100 to 240V AC, varnish finish)	
HD-PLBS400S	DOPL II S non-redundant units (100 to 240V AC)	
HD-PLBS400SC	DOPL II S non-redundant units (100 to 240V AC, varnish finish)	
HD-PLBS401R	DOPL II S redundant units (24V DC)	Redundant link cable × 1
HD-PLBS401RC	DOPL II S redundant units (24V DC, varnish finish)	
HD-PLBS401S	DOPL II S non-redundant units (24V DC)	
HD-PLBS401SC	DOPL II S non-redundant units (24V DC, varnish finish)	

Optional parts

Model No.	Name	Remarks
HD-PLBSMB001	Mounting bracket (type 1)	For DOPL II S
HD-PLBSMB002	Mounting bracket (type 2)	For DOPL II/PL-EX
HD-PLBSCB001	Cable support bar	Holds cables in place.

Note: The mounting brackets and cable support bar are sold separately, not included with the product. If necessary, please order them.

AC power cable

Power supply cable for DOPL II S of AC models.

Model No.	Name	Remarks
HD-PLACA075	DOPL II S AC power cable, 0.75 m	*AC power models are available in Japan only.
HD-PLACA150	DOPL II S AC power cable, 1.5 m	

DC power cable

Power supply cable for DOPL II S DC models.

Model No.	Name	Remarks
HD-PLDCA050	DOPL II /DOPL II S DC input cable (crimp contact), 0.5 m	DOPL II S side: connector pins DC supply side: terminals
HD-PLDCA100	DOPL II /DOPL II S DC input cable (crimp contact), 1 m	
HD-PLDCA150	DOPL II /DOPL II S DC input cable (crimp contact), 1.5 m	
HD-PLDCA200	DOPL II /DOPL II S DC input cable (crimp contact), 2 m	
HD-PLDCA250	DOPL II /DOPL II S DC input cable (crimp contact), 2.5 m	
HD-PLDCA300	DOPL II /DOPL II S DC input cable (crimp contact), 3 m	
HD-PLDCA350	DOPL II /DOPL II S DC input cable (crimp contact), 3.5 m	
HD-PLDCA400	DOPL II /DOPL II S DC input cable (crimp contact), 4 m	
HD-PLDCA450	DOPL II /DOPL II S DC input cable (crimp contact), 4.5 m	
HD-PLDCA500	DOPL II /DOPL II S DC input cable (crimp contact), 5 m	
HD-PLDCC050	DOPL II /DOPL II S DC input cable, 0.5 m	Double-ended connector is used in the case of DC-PDU.
HD-PLDCC100	DOPL II /DOPL II S DC input cable, 1 m	
HD-PLDCC150	DOPL II /DOPL II S DC input cable, 1.5 m	
HD-PLDCC200	DOPL II /DOPL II S DC input cable, 2 m	
HD-PLDCC250	DOPL II /DOPL II S DC input cable, 2.5 m	
HD-PLDCC300	DOPL II /DOPL II S DC input cable, 3 m	
HD-PLDCC350	DOPL II /DOPL II S DC input cable, 3.5 m	
HD-PLDCC400	DOPL II /DOPL II S DC input cable, 4 m	
HD-PLDCC450	DOPL II /DOPL II S DC input cable, 4.5 m	
HD-PLDCC500	DOPL II /DOPL II S DC input cable, 5 m	

RAS external contact output cable
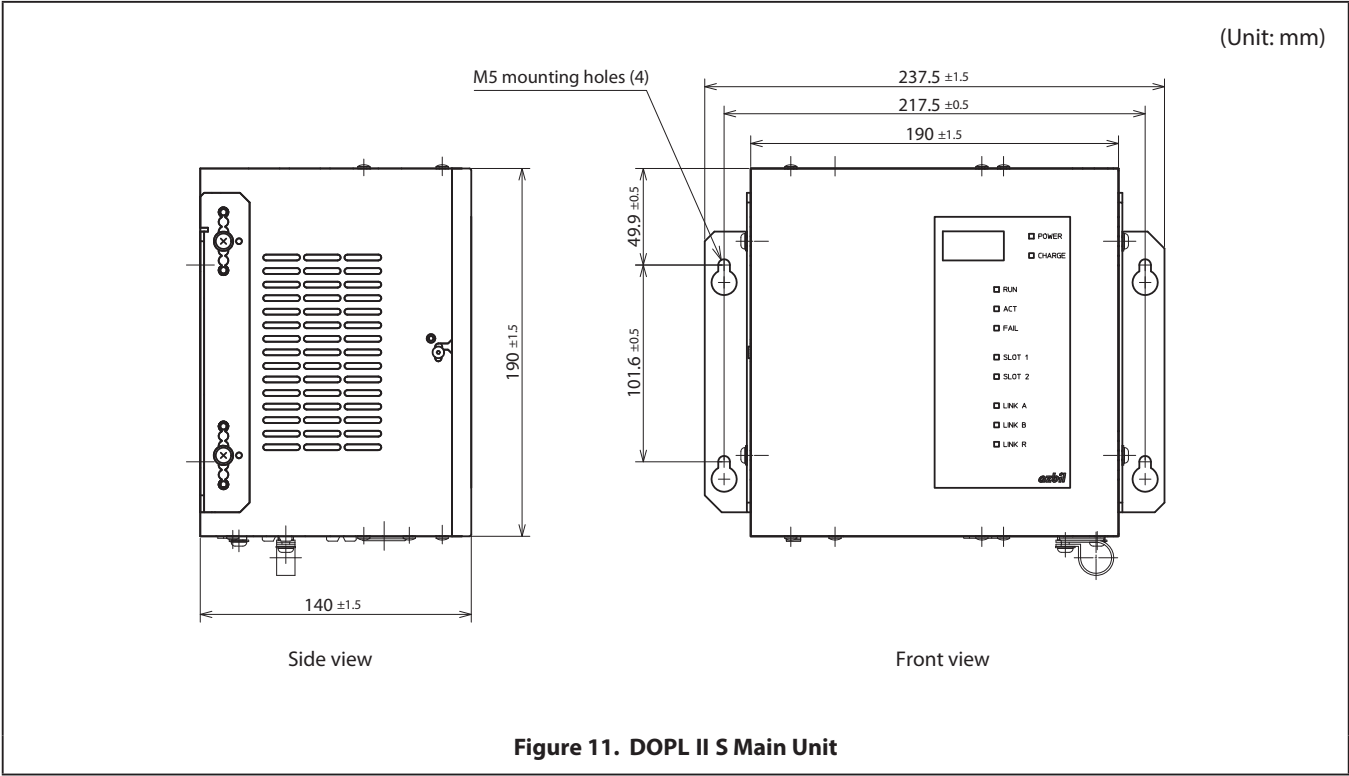
This cable is used to output a DOPL II S stop signal.

Model No.	Name	Remarks
HD-PLEXCB01	RAS external contact output cable, 1 m	
HD-PLEXCB02	RAS external contact output cable, 2 m	
HD-PLEXCB03	RAS external contact output cable, 3 m	
HD-PLEXCB04	RAS external contact output cable, 4 m	
HD-PLEXCB05	RAS external contact output cable, 5 m	

Maintenance parts (with a limited service life)

Model No.	Name	Remarks
HD-PLBSPS001	Power supply unit (100–240 V AC, varnished)	Recommended replacement period: 10 years*
HD-PLBSPS002	Power supply unit (24 V DC, varnished)	Recommended replacement period: 10 years*

* The recommended replacement period is based on the maximum ambient temperature (35 °C) if the product is installed in the standard cabinet.
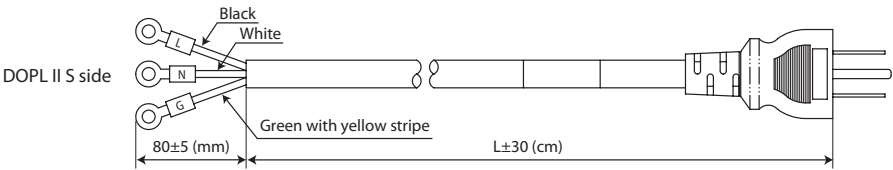
15. External Dimensions

(Unit: mm)

M5 mounting holes (4)

237.5 ±1.5

217.5 ±0.5

190 ±1.5

49.9 ±0.5

101.6 ±0.5

190 ±1.5

140 ±1.5

POWER
CHARGE

RUN
ACT
FAIL

SLOT 1
SLOT 2

LINK A
LINK B
LINK R

azbil

Side view   Front view

Figure 11. DOPL II S Main Unit

• **Cable**

(Unit: mm)

Figure 12. AC power cable, HD-PLACA*** (***: 075/150 cm)
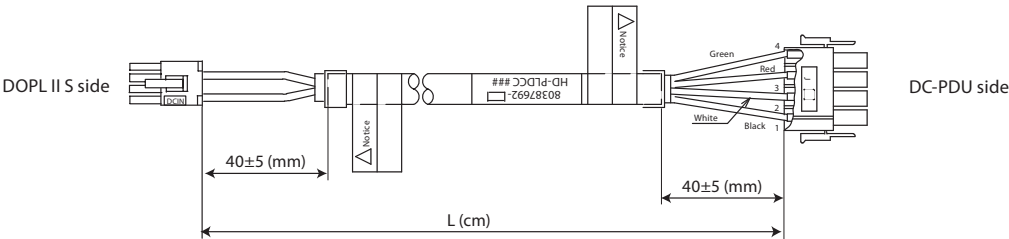
Figure 13. DC power cable, HD-PLDCC*** (***: 050 to 500 cm, in 50 cm increments)

Signal name	Line color
+24V	Red
24VB	White
COM	Black
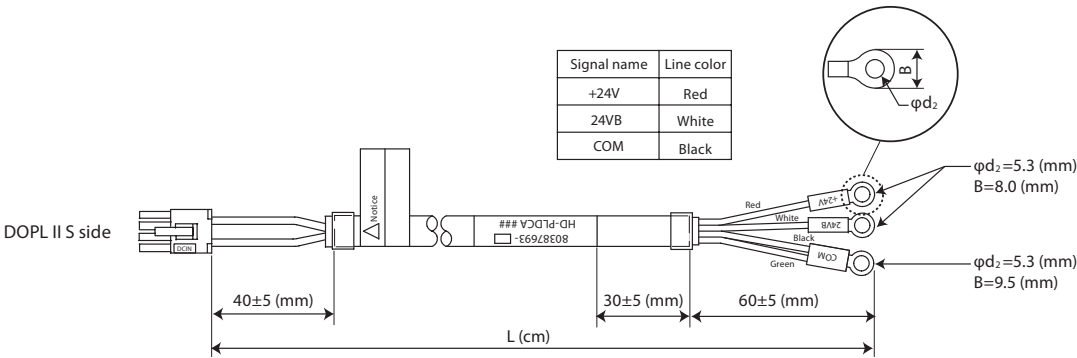
Figure 14. DC power cable, HD-PLDCA*** (***: 050 to 500 cm, in 50 cm increments)

Signal name	Line color
+24V	Red
WDT	Green
COM	White
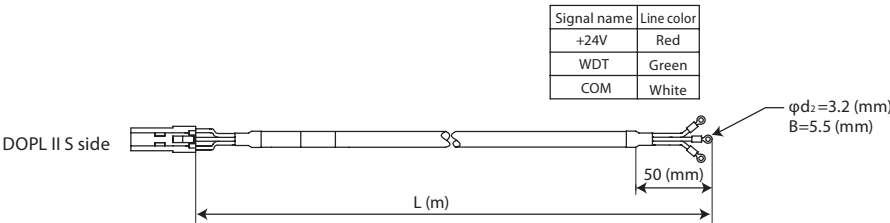
Figure 15. RAS external contact output cable, HD-PLEXCB** (**: 01 to 05 m)

16. Connection to Other Systems

In the following cases, the initial response, delineation and analysis work associated with a communication failure between DOPL II S and connected device (i.e. subsystem) will not be provided free of charge:

- The subsystem was not sourced from Azbil Corporation
- The cable and/or devices used to connect the subsystem to DOPL II S were not sourced from Azbil Corporation

- Harmonas-DEO, DOHS, DOPL and DOPC are registered trademarks of Azbil Corporation in Japan.
- Ethernet is a registered trademark of XEROX Corporation.
- MELSEC and MELSECNET/10 are trademarks of Mitsubishi Electric Corporation, Ltd.
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