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[Title] Year 2000 Problem for Programmable Logical Controller and GOT Embedding System [Date of Issue] July '99

[Relevant Models] MELSEC-K/A/QnA Series and GOT Series

Thank you for your continued patronage of the Mitsubishi general-purpose programmable logic controller MELSEC-K/A/QnA Series and graphic operation terminal GOT Series.

Whereas

[Details]

1. Outline of Year 2000 Problem for Embedding System

Initially, problems related to the year 2000 problem focused on the processing of the last two digits in the year. However, currently problems related to embedding systems have been picked up. The embedding system here refers to the microprocessor built into the device and the silicon chips for the various ICs, etc. These parts that have an effect on the year 2000 problem are those having a clock element (RTC) in the embedding system. It is necessary to verify that there is no year 2000 problem (including correspondence to leap years) in these embedding systems. At Mitsubishi, we have used to SEMATECH (U.S. Semiconductor Manufacturing Technology Research Foundation) year 200 problem test standards to verify this problem.

2. Models subject to embedding system year 2000 problem

The products having a clock element (RTC) in the module are listed below.

- AnNCPU (n = 1, 2, 3)
- AnACPU (n = 2, 3)
- AnUCPU (n = 1, 2,3)
- A1SCPU
- A1SCPUC24–R2
- A1SHCPU
- A1SJCPU (–S3)
- A73CPU (–S3)
- A7BD-A3N
- A1SJHCPU
- A2SCPU
- A2SHCPU
- A2USCPU (–S1)
- A2USHCPU–S1
- A1FXCPU
- A2CCPUC24 (–PRF)
- A52GCPU
- KGPC1
- KGPC11 (MCPU)
- QnACPU (n = 2, 3, 4)
- Q4ARCPU
- Q2ASCPU (–S1)
- Q2ASHCPU (–S1)
- AD51 (–S3)
- AD51E (–S3)
- KD51
- KD51E

Reference : The CPU module with data link is included in the above models.

3. Models not subject to embedding system year 2000 problem

Models not listed in the previous section do not have an internal clock element (RTC), and thus are not subject to this problem.

The general GOT Series and AD51H(-S3) and A1SD51S have a clock function, but do not have an internal clock element (RTC). Instead, the data in the PLC CPU clock element (RTC) is read to establish the clock function.

Note that the following modules also do not have a clock element (RTC), and thus are not subject to this problem.

- Power supply module
- Position detection module
- Positioning module
- Analog input/output module
- Other special modules
- Temperature input, temperature regulating module
- Input/output module
- Communication, network module
- High counter module

4. Presence of embedding system year 2000 problem in PLC related modules

The PLC related units having a clock element (RTC) can be largely classified into five classes. The following test has been carried out one each clock element (RTC), and it has been confirmed that there are no problems as the embedding system.

Refer to the List of presence of embedding system year 2000 problem in PLC related modules on page 4/8 for details.

5. Test details and results of embedding system year 2000 problem in PLC related modules

To test whether the PLC related unit had a problem in respect to the embedding system year 2000 problem, we referred to the year 2000 problem compliance test standards specified by SEMATECH (U.S. Semiconductor Manufacturing Technology Research Foundation), and of the 31 test items, picked out 15 items related to the PLC related module embedding system. Refer to page 5/8 and following for the test details and results.

6. Mechanism of PLC CPU module clock circuit, and leap year process

The PLC CPU modules with a clock function have an internal clock element (RTC). The configuration of this clock element (RTC) circuit and the mechanism of the clock circuit are explained below.

In Fig. 1, the clock element (RTC) in the module first counts the one-second unit reference clock with the "second counter". When the "second counter" counts 60, the "minute counter" counts one. The "hour counter", "date counter", "month counter" and "year counter" each count in sequence to output the calendar data. These operations are carried out in the clock terminal (RTC) backed up with a battery even when the PLC power is turned OFF.

The year data here is handled with the last two digits of the year. The year digit interprets "00", "04", "08" ... "92" and "96" as leap years. This process is carried out by the leap year detection circuit in the clock terminal (RTC). Thus, the year 2000 will also be judged as a leap year and processed correctly. (The year digit for the year 2000 is "00".) In precise terms, the year 2000 is a leap year, and as the year 1900 and 2100, which cannot be divided by 400, are not leap years. However, as this clock circuit can handle only two digits of the year data, the year 1900 and year 2000 will be recognized as leap years. However, as the current PLC will not be used up to the year 2100, there will be no practical problems.

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The interface with the actual sequence program is as shown below.
In other words, the CPU module constantly reads the contents of the clock element (RTC) counter when the special relay M9028 is ON, and stores the information in the special register (D9025-D9028). The user can find the clock data by reading the contents of this special register with the sequence program.
When the clock data is initially set to the clock element (RTC), set the clock data to be set in the special register, and then turn the clock data set request special relay (M9025) ON. With this, the clock data will be set in the clock data preset register in the clock element (RTC), and after the sequence program END command is executed, the clock data will be preset in the clock counter.
With the above mechanism, the clock data in the PLC will be correctly and automatically judged as a leap year until the year 2099 (in precise terms, February 28, 2100).
(The above explanation is for the MELSEC-A Series CPU, but also applies to the QnA Series CPU, except that the numbers of the special relay and special registers are different.)
The five types of clock elements (RTC) explained in section 4 all have the same type of circuit configuration, and carry out the same type of process.

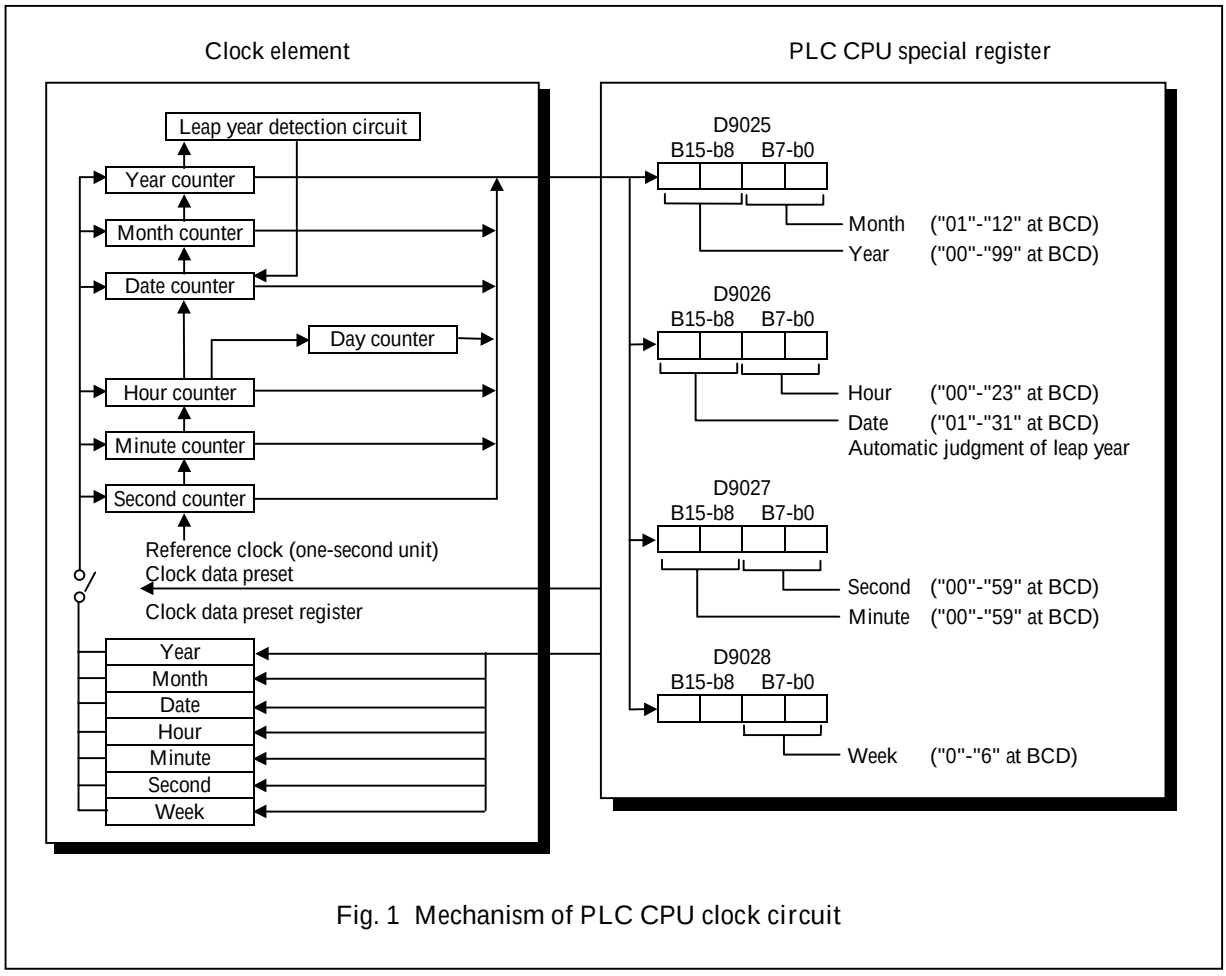

Fig. 1 Mechanism of PLC CPU clock circuit

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List of presence of embedding system year 2000 problem in PLC related modules

No.		1	2	3	4	5
Part name		CPU module	CPU module	CPU module	CPU module	Intelligent communication module, etc.
PLC related module type		AnNCPU, A2SCPU, A2CCPUC24 (-PRF), A73CPU (-S3), A52GCPU, A7BD-A3N	A1SCPU, A2SCPUC24-R2, A1SJCPU (-S3)	A1SJHCPU, A1SHCPU, A2SHCPU, A1FXCPU	AnACPU, AnUCPU, A2USCPU (-S1), A2USHCPU-S1, QnACPU, Q4ARCPU, Q2ASCPU (-S1), Q2ASHCPU (-S1)	AD51 (-S3), AD51E (-S3), KD51, KD51E, KGPC1, KGPC11 (MCPU)
Embedding system (System with clock element (RTC) are described)	Type No.	RTC-62421A	Built into Mitsubishi dedicated LSI	Built into Mitsubishi dedicated microprocessor	Built into Mitsubishi dedicated microprocessor	HD146818P
	No. of year digits	Last two digits	Last two digits	Last two digits	Last two digits	Last two digits
	Chip maker	Seiko-Epson	Mitsubishi Electric	Mitsubishi Electric	Mitsubishi Electric	Hitachi
	Qty. used	One pc.	One pc.	One pc.	One pc.	One pc.
	Calendar function valid period	Feb. 28, 2100	Feb. 28, 2100	Feb. 28, 2100	Feb. 28, 2100	Feb. 28, 2100
	Presence of year 2000 problem	None	None	None	None	None (Note)
Problem presence confirmation method		Tested with SEMATECH test standards	Tested with SEMATECH test standards	Tested with SEMATECH test standards	Tested with SEMATECH test standards	Tested with SEMATECH test standards
Remark						Refer to the (Note).

(Note) The clock data is written into the intelligent communication module clock element with the date and time setting in the GPC-BASIC SCA command or SW0GHP-AD51PC software package. However, February 29, 2000 (00/2/29) cannot be set. Although this cannot be set, the system will shift without problem from February 28, 2000 to February 29, 2000, or from February 29, 2000 to March 1, 2000. This is a restriction applied by the Mitsubishi software, and is not a problem with the embedding system (clock element). Although February 29, 2000 cannot be set because of the software, other dates can be set. Refer to the Mitsubishi PLC Technical Bulletin (No. PLC-D-326) regarding the intelligent communication module year 2000 problem for details.

Test details and results of PLC related module year 2000 problem

1) Test details

The following tests were carried out to confirm whether there was a year 2000 problem in the PLC related modules. The year 2000 problem compliance test standards specified by SEMATECH (U.S. Semiconductor Manufacturing Technology Research Foundation) were referred to, and of the 31 test items, 15 items related to the PLC related module embedding system were picked out and tested.
The correspondence of each test item and test No. is shown below.

Class	Test item	Test No.
Setting and holding of date data	Setting and holding of millennium date (Jan. 1, 2000)	TEST1
	Setting and holding of leap year date (Feb. 29, 2000)	TEST2
	Setting and holding of leap year date + 1 day (March 1, 2000)	TEST3
	Setting of millennium date (Jan. 1, 2000), and holding of date when power is turned OFF/ON	TEST4
	Setting of leap year date (Feb. 29, 2000), and holding of date when power is turned OFF/ON	TEST5
	Setting and holding of Sept. 9, 1999	TEST29
Changing of date (When PLC power is turned ON)	Shifting from Dec. 31, 1999 to Jan. 1, 2000 (Confirmation of change at millennium)	TEST6
	Recognition of year 2000 as leap year, and shift from Feb. 28 to Feb. 29, 2000 (Confirmation of leap year)	TEST7
	Shifting from Feb. 29, 2000 to March 1, 2000 (confirmation of millennium and leap year)	TEST8
	Shifting from Dec. 31, 2000 to Jan. 1, 2001 (Confirmation of century (21st century))	TEST26
	Shifting from Sept. 8, 1999 to Sept. 9, 1999 (Confirmation of date with many 9s)	TEST30
Changing of date (When PLC power is turned OFF)	Shifting from Dec. 31, 1999 to Jan. 1, 2000 (Confirmation of change at millennium)	TEST9
	Recognition of year 2000 as leap year, and shift from Feb. 28 to Feb. 29, 2000 (Confirmation of leap year)	TEST10
	Shifting from Dec. 31, 2000 to Jan. 1, 2001 (Confirmation of century (21st century))	TEST27
	Shifting from Sept. 8, 1999 to Sept. 9, 1999 (Confirmation of date with many 9s)	TEST31

(Note) Setting and holding the date data confirms that the date data is correctly set when the date is set, and that the data is correctly held.
Changing of data when the PLC power is turned ON confirms that the clock data has been correctly processed when the PLC power is turned ON.
The change when the PLC power is turned OFF confirms that the clock element backed up with a battery correctly operates when the PLC power is turned OFF.

2) Test results

Refer to the list of test results below.

List of results of embedding system year 2000 problem in PLC related modules

Test details	Results
TEST 1 Setting and holding millennium data 1. Set built-in clock to Jan. 1, 2000 01:01:01. 2. Is the system date Jan. 1, 2000? 3. If the system has a day function, is the day Saturday?	Normal
TEST 2 Setting and holding leap year 1. Set built-in clock to Feb. 29, 2000 01:01:01. 2. Is the system date Feb. 29, 2000? 3. If the system has a day function, is the day Tuesday?	Normal (Note 1)
TEST 3 Setting and holding leap year date + one day 1. Set built-in clock to Mar. 1, 2000 01:01:01. 2. Is the system date Mar. 1, 2000? 3. If the system has a day function, is the day Wednesday?	Normal
TEST 4 Setting and holding millennium date after turning power ON 1. Set built-in clock to Jan. 1, 2000 01:01:01. 2. Turn power OFF. 3. Wait two minutes. 4. Turn power ON. 5. Is the system date Jan. 1, 2000? 6. If the system has a day function, is the day Saturday?	Normal
TEST 5 Setting and holding leap year date after power ON. 1. Set built-in clock to Feb. 29, 2000 01:01:01. 2. Turn power OFF. 3. Wait two minutes. 4. Turn power ON. 5. Is the system date Feb. 29, 2000? 6. If the system has a day function, is the day Wednesday?	Normal (Note 1)
TEST 6 Basic changes in millennium data 1. Set built-in clock to Dec. 31, 1999 23:59:00. 2. Wait two minutes. 3. Is the system date Jan. 1, 2000? 4. If the system has a day function, is the day Saturday?	Normal
TEST 7 Basic changes in leap year date 1. Set built-in clock to Feb. 28, 2000 23:59:00. 2. Wait two minutes. 3. Is the system date Feb. 29, 2000? 4. If the system has a day function, is the day Tuesday?	Normal

Test details	Results
TEST 8 Setting and holding leap year date + one day 1. Set built-in clock to Feb.29, 2000 23:59:00. 2. Wait two minutes. 3. Is the system date Mar. 1, 2000? 4. If the system has a day function, is the day Wednesday?	Normal (Note 1)
TEST 9 Setting and holding millennium date after turning power ON 1. Set built-in clock to Dec. 31, 1999 23:59:00. 2. Turn power OFF. 3. Wait two minutes. 4. Turn power ON. 5. Is the system date Jan. 1, 2000? 6. If the system has a day function, is the day Saturday?	Normal
TEST 10 Setting and holding leap year date after power ON 1. Set built-in clock to Feb. 28, 2000 23:59:00. 2. Turn power OFF. 3. Wait two minutes. 4. Turn power ON. 5. Is the system date Feb. 29, 2000? 6. If the system has a day function, is the day Tuesday?	Normal
TEST 26 Basic changes in Jan. 1, 2001 1. Set built-in clock to Dec.31, 2000 23:59:00. 2. Wait two minutes. 3. Is the system date Jan. 1, 2001? 4. If the system has a day function, is the day Monday?	Normal
TEST 27 Basic changes in Jan. 1, 2001 after power ON 1. Set built-in clock to Dec. 31, 2000 23:59:00. 2. Turn power OFF. 3. Wait two minutes. 4. Turn power ON. 5. Is the system date Jan. 1, 2001? 6. If the system has a day function, is the day Monday?	Normal
TEST 29 Setting and holding Sept. 9, 1999 1. Set built-in clock to Sept.9, 1999 01:01:01. 2. Is the system date Sept. 9, 1999? 3. If the system has a day function, is the day Thursday?	Normal
TEST 30 Basic changes in Sept. 9, 1999 1. Set built-in clock to Sept.8, 1999 23:59:00. 2. Wait two minutes. 3. Is the system date Sept. 9, 1999? 4. If the system has a day function, is the day Thursday?	Normal

Test details	Results
TEST 31 Basic changes in Sept. 9, 1999 1. Set built-in clock to Sept. 8, 1999 23:59:00. 2. Turn power OFF. 3. Wait two minutes. 4. Turn power ON. 5. Is the system date Sept. 9, 1999? 6. If the system has a day function, is the day Thursday?	Normal

(Note 1) February 29, 2000 cannot be set with the intelligent communication module (AD51, KD51, etc.)

(Note 2) The PLC CPU can handle day data, but once the day date is input, it is updated in day units. Note that the day data corresponding to the date data must be input once.

(Note 3) With the test, the date data was set into the PLC clock function special register with the PLC program and peripheral device. For the intelligent communication module, the date data was set from the BASIC program and peripheral device.

7. Precautions for user application program

Finally, in respect to the year 200 problem for the PLC related unit embedding system, there is basically no problem as described earlier.

However, as the PLC related unit's year is handled with the last two digits, the year 1999 will be "99", and the year 2000 will be "00". If a process to compare the year data size or to delete old data is carried out with the user application program (user sequence program, user BASIC program, etc.), the size of the year 2000 data will be reversed in size, so the process will not be carried out correctly with the user application. In this case, correct the user application program so that the year data is processed with four digits instead of two digits. Refer to the Mitsubishi Programmable Logic Controller Technical Bulletin (No. T99-0005) "Handling of problem in the year 2000 for all CPU modules in MELSEC-A/Q Series" for details.

The user must confirm whether the above problem will occur with the user application, and must revise the user application program is any problem could occur.