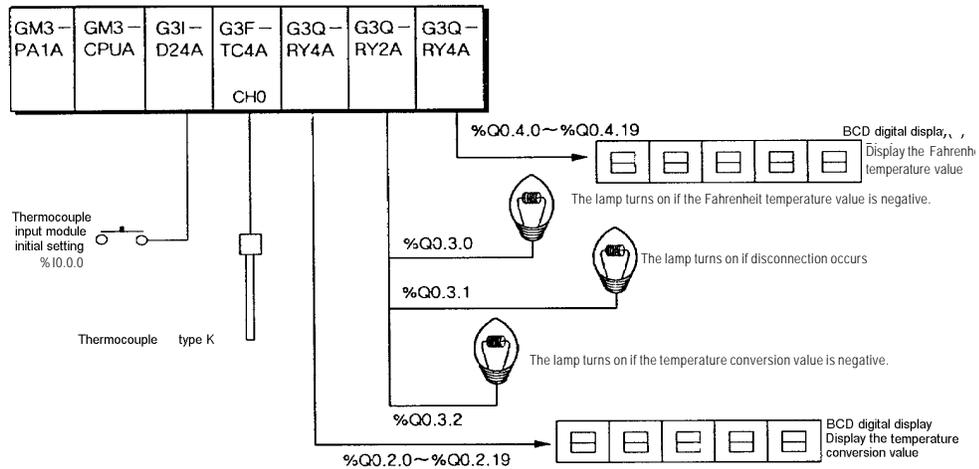


## Chapter 5. PROGRAMMING

### 5.1 A program for Converting a Detected Temperature Value(° C) into Fahrenheit(° F) and Outputting as a BCD Value

#### 1) System Configuration



#### 2) Initial settings

- (1) Specifying the used channel: channel 0
- (2) Specifying the type of the thermocouple : Type K

#### 3) Expression for conversion of a temperature conversion value into a Fahrenheit temperature(° F)

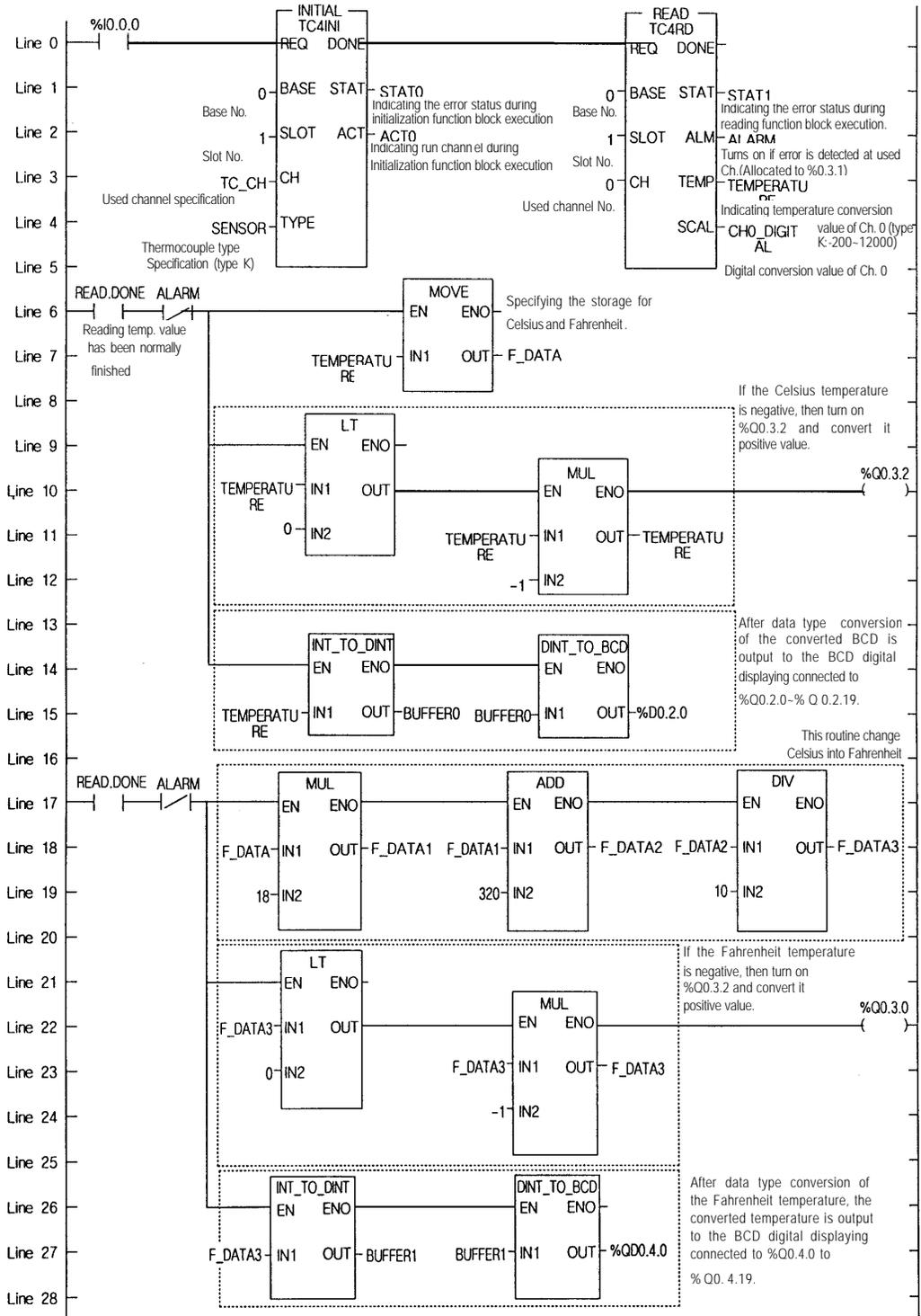
$$\begin{aligned}
 \text{Temperature conversion value} &= \text{Detected temperature value} \times 10 \\
 \text{Fahrenheit temperature(°F)} &= \text{Detected temperature value} \times 1.8 + 32 \\
 &= \frac{\text{Temperature conversion value}}{10} \times 1.8 + 32 \\
 &= \frac{\text{Temperature conversion value} \times 18 + 320}{10}
 \end{aligned}$$

∴ If the Fahrenheit temperature displayed on the BCD digital display is displayed with the value of 'detected Fahrenheit temperature (°F) × 10', then it is needed to process the expression "temperature conversion value × 18 + 320".

#### 4) Program Description

- (1) If %I0.0.0 turns on then the thermocouple input module would be initialized.
- (2) The temperature conversion value is displayed on the BCD digital display of %Q0.2.0 to %Q0.2.19. If the value is negative the ramp %Q0.3.2 will turn on.
- (3) After the conversion of the temperature conversion value into a Fahrenheit temperature (°F), it will be displayed on the BCD digital display of %Q0.4.0 to %Q0.4.19. If it is negative the ramp %Q0.3.0 will turn on.
- (4) If disconnection is detected during conversion of temperature of the channel 0, the ramp %Q0.3.1 will turn on.

5) Program



6) Initial Value Setting Method for I/O Variables

(1) Channel Specification

The image shows three overlapping dialog boxes used for setting initial values for I/O variables.

**Add/Edit Variables Dialog:**

- Variable Name: TC\_CH
- Variable Kind: VAR
- Data Type:
  - Elementary: BOOL
  - FB Instance: AD4ARD
  - Array: (0..15) OF BOOL
- Memory Allocation: Auto
- Buttons: OK, Cancel, Help, Init. Array...

**Initialize Array Dialog:**

- Array Name: TC\_CH : ARRAY [0..15] OF BOOL
- Options: No Init, Initialize (selected)
- Buttons: Close, Help, Edit...

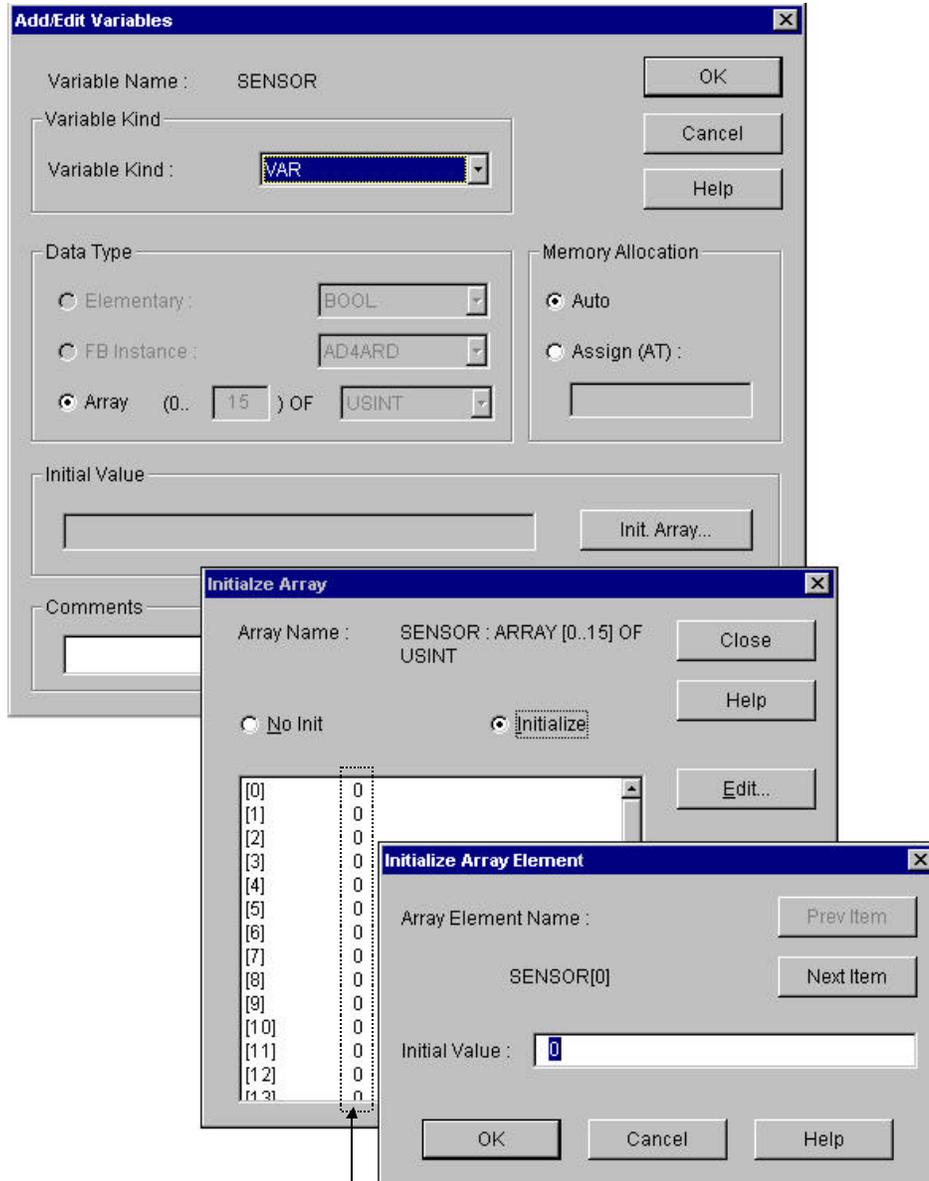
**Initialize Array Element Dialog:**

- Array Element Name: TC\_CH[0]
- Initial Value: 0
- Buttons: OK, Cancel, Help, Prev Item, Next Item

**Annotations:**

- "This denotes 16 channels" points to the "Array (0..15) OF" field in the first dialog.
- "Select this and this screen appears" points to the "Init. Array..." button in the first dialog.
- "Select this and this screen appears" points to the "Initialize" radio button in the second dialog.
- "Select this and this screen appears" points to the "Edit..." button in the second dialog.
- "Selection of the previous channel" points to the "Prev Item" button in the third dialog.
- "Selection of the next channel" points to the "Next Item" button in the third dialog.
- "Channel enable/disable specification" points to the "Initial Value" field in the third dialog.
- "Channel No." points to the list of channel numbers in the second dialog.
- "Channel enable : 1" and "Channel disable : 0" are labels for the values in the list.

(2) Thermocouple Type Specification



Thermocouple type specification

Input specification No.	Sensor type	Temperature range
0	K	-200.0 to 1200.0°C
1	J	-200.0 to 800.0°C
2	E	-150.0 to 600.0°C
3	T	-200.0 to 400.0°C
4	B	400.0 to 1800.0°C
5	R	0.0 to 1750.0°C
6	S	0.0 to 1750.0°C

7) I/O Variables Used in the Program

Variable Name	Var_Kind	Data Type	(AT Address)	(Initial Value)
ACT0	: VAR	: ARRAY [0..15] OF BOOL		
ALARM	: VAR	: BOOL	AT %Q0.3.1	
BUFFER0	: VAR	: DINT		
BUFFER1	: VAR	: DINT		
CHO_DIGITAL	: VAR	: INT		
F_DATA	: VAR	: INT		
F_DATA1	: VAR	: INT		
F_DATA2	: VAR	: INT		
F_DATA3	: VAR	: INT		
INITIAL	: VAR	: FB Instance		: = { 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 }
READ	: VAR	: FB Instance		
SENSOR	: VAR	: ARRAY [0..15] OF USINT		
STAT0	: VAR	: USINT		
STAT1	: VAR	: USINT		
TC_CH	: VAR	: ARRAY [0..15] OF BOOL		: = { 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 }
TC_INI	: VAR	: FB Instance		
TEMPERATURE	: VAR	: INT		

## 5.2 A program for Magnitude Comparison of a Detected Temperature Value

### 1) System Configuration

GM3 – PA1A	GM3 – CPUA	G3F – TC4A	G3Q – RY2A		
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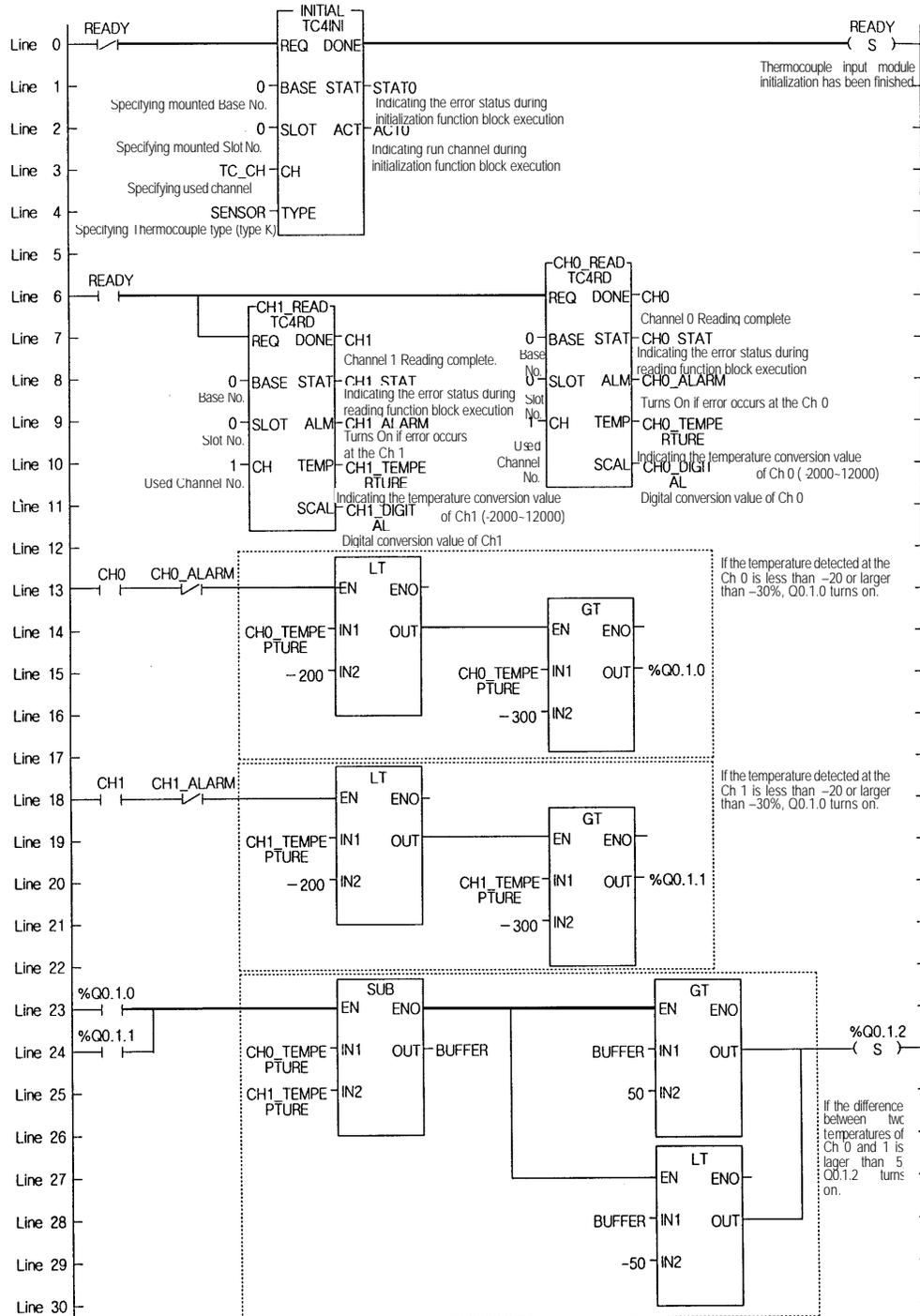
### 2) Initial Settings

- (1) Used Channel : Channel 0 and 1
- (2) Thermocouple type specification : Type K

### 3) Program Descriptions

- (1) If the temperature that is input through the channel 0 of the thermocouple input module is less than  $-20^{\circ}\text{C}$  or larger than  $-30^{\circ}\text{C}$ , %Q0.1.0 turns on.
- (2) If the temperature that is input through the channel 1 of the thermocouple input module is less than  $-20^{\circ}\text{C}$  or larger than  $-30^{\circ}\text{C}$ , %Q0.1.1 turns on.
- (3) If the difference between the two temperatures that are input through the channel 0 and 1 is larger than  $5^{\circ}\text{C}$ , %Q0.1.2 turns on.

4) Program

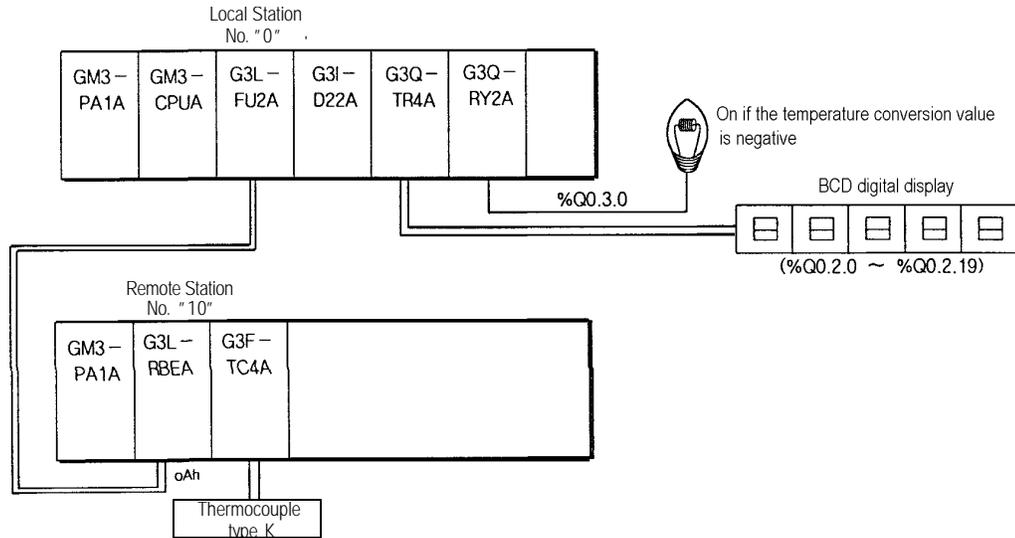


5) I/O Variables Used in the Program

Variable Name	Var_Kind	Data Type	(AT Address)	(Initial Value)
ACT0	: VAR	: ARRAY [0..15] OF BOOL		
BUFFER	: VAR	: INT		
CH0	: VAR	: BOOL		
CH0_ALARM	: VAR	: BOOL		
CH0_DIGITAL	: VAR	: INT		
CH0_READ	: VAR	: FB Instance		
CH0_STAT	: VAR	: USINT		
CH0_TEMPERATURE	: VAR	: INT		
CH1	: VAR	: BOOL		
CH1_ALARM	: VAR	: BOOL		
CH1_DIGITAL	: VAR	: INT		
CH1_READ	: VAR	: FB Instance		
CH1_STAT	: VAR	: USINT		
CH1_TEMPERATURE	: VAR	: INT		
INITIAL	: VAR	: FB Instance		
READY	: VAR	: BOOL		
SENSOR	: VAR	: ARRAY [0..15] OF USINT		:= { 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 }
STAT0	: VAR	: USINT		
TC_CH	: VAR	: ARRAY [0..15] OF BOOL		:= { 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 }

**5.3 A Program Used When Mounting a Thermocouple Input Module onto the Remote I/O Station**

**1) System Configuration**



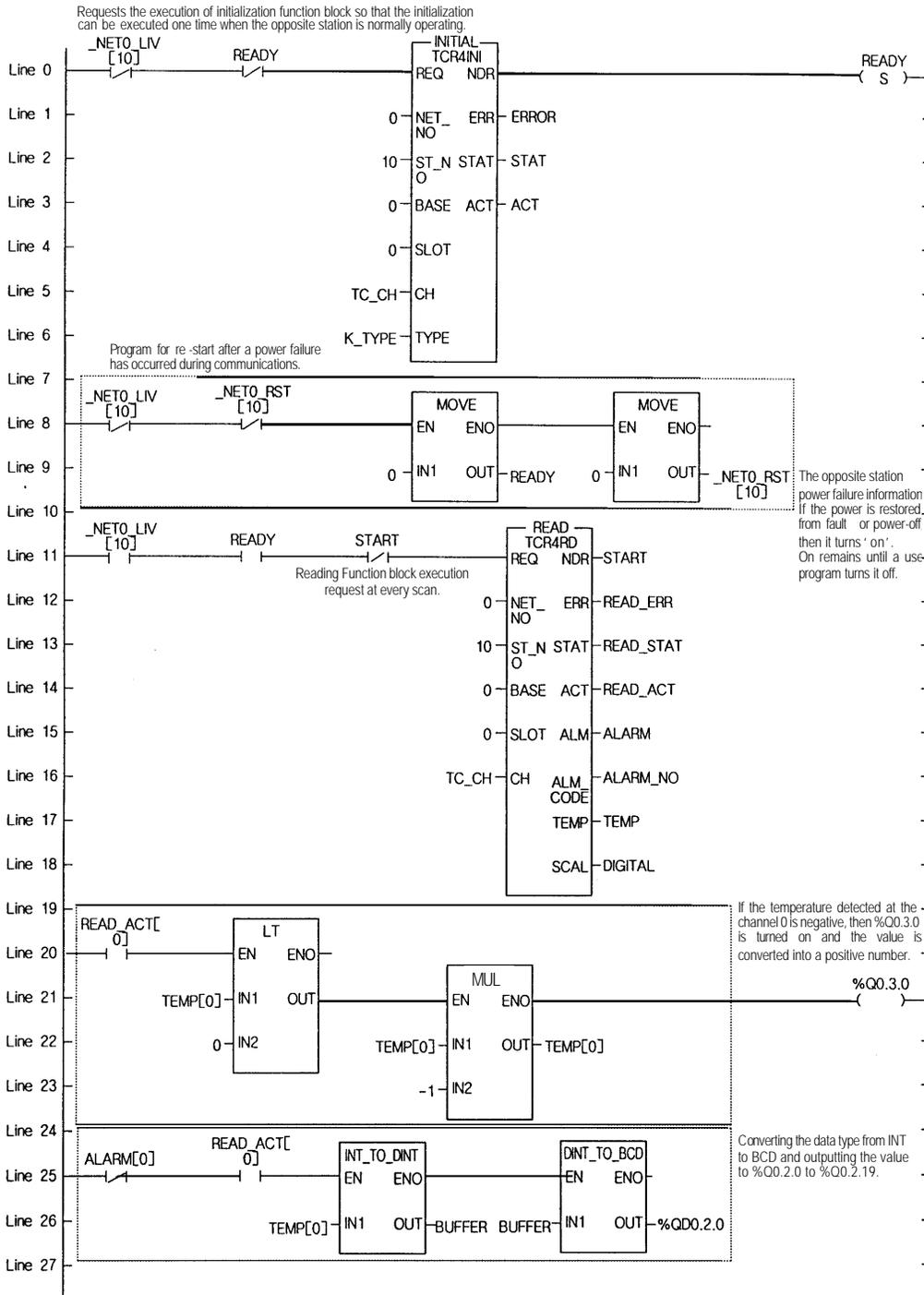
**2) Initial Settings**

- (1) Specifying used channel : Channel 0
- (2) Specifying thermocouple type: Type K

**3) Program Description**

- (1) `_NET0_LIV[10]` : Turns "On" if the local normally communicates with the remote.
- `_NET0_RST[10]` : Turns "On" if communications error or power failure occurs. The user has to turn it off forcibly when the normal state has been restored.
- (2) If the temperature conversion value is negative, %Q0.3.0 will be turned "On" and the value will be changed into a positive value.
- (3) If no error has been occurred during execution of the reading function block, the temperature conversion value will be output to "%Q0.2.0".

4) Program



5) I/O Variables Used in the Program

Variable Name	Var_Kind	Data Type	(AT Address)	(Initial Value)
ACT0	: VAR	: ARRAY [0..15] OF BOOL		
BUFFER	: VAR	: INT		
CH0	: VAR	: BOOL		
CH0_ALARM	: VAR	: BOOL		
CH0_DIGITAL	: VAR	: INT		
CH0_READ	: VAR	: FB Instance		
CH0_STAT	: VAR	: USINT		
CH0_TEMPERATURE	: VAR	: INT		
CH1	: VAR	: BOOL		
CH1_ALARM	: VAR	: BOOL		
CH1_DIGITAL	: VAR	: INT		
CH1_READ	: VAR	: FB Instance		
CH1_STAT	: VAR	: USINT		
CH1_TEMPERATURE	: VAR	: INT		
INITIAL	: VAR	: FB Instance		
READY	: VAR	: BOOL		
SENSOR	: VAR	: ARRAY [0..15] OF USINT	:= { 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 }	
STAT0	: VAR	: USINT		
TC_CH	: VAR	: ARRAY [0..15] OF BOOL	:= { 1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 }	