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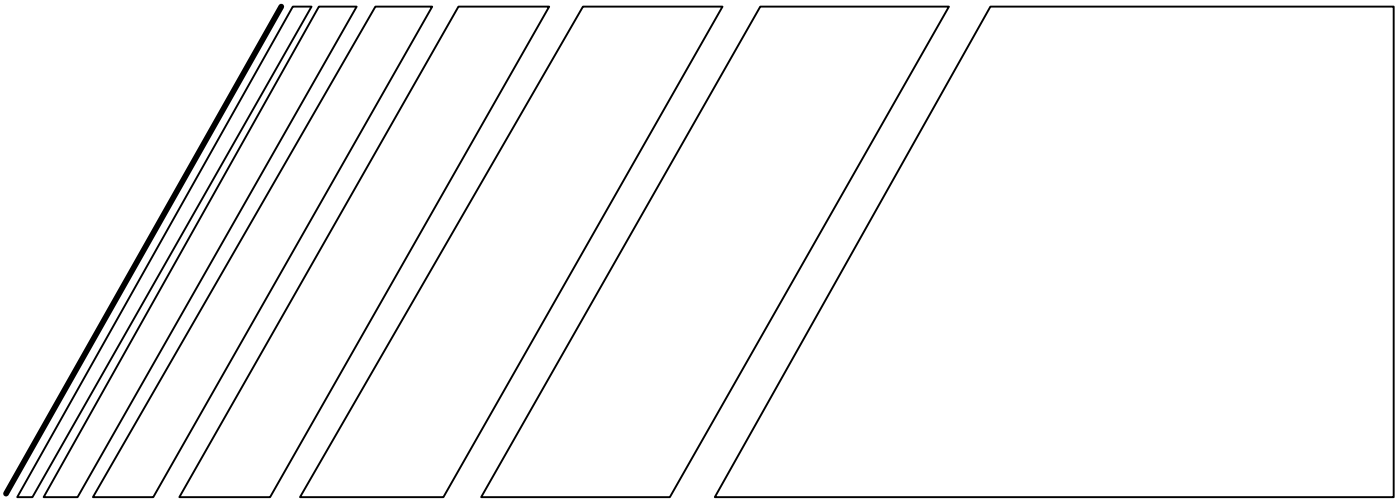
OMRON



USER'S MANUAL

Programmable Controller Option Board

MODELS 3G3RV- P10ST8-E AND 3G3RV- P10ST8-DRT-E

(For Varispeed F7Z/E7Z/L7Z/G7C Inverters)

3G3RV-P10ST PLC Option Board

User's Manual

Revised March 2005

Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always consult the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

⚠ **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

OMRON Product References

All OMRON products are capitalised in this manual. The word “Unit” is also capitalised when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PLC” means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

1, 2, 3… 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

TABLE OF CONTENTS

About this Manual:

The 3G3RV-P10ST is a high-speed Programmable Controller (PLC) with a build-in F7Z/E7Z/L7Z/G7C Inverter interface. There are two manuals describing the setup and operation of the 3G3RV-P10ST: The *3G3RV-P10ST Operation Manual* (this manual) and the *CPM1/ CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353). (The *CPM1/CPM1A/CPM2A/ CPM2C/SRM1(-V2) Programming Manual* is referred to as simply the *Programming Manual* in this manual.) This manual describes the system configuration and installation of the 3G3RV-P10ST and provides a basic explanation of operating procedures for the Programming Consoles. Read this manual first to acquaint yourself with the 3G3RV-P10ST.

Refer to the following User's manuals for descriptions of the specifications and installation of the applicable Inverters: Varispeed L7 (TOMCC71067600AA-OY), Varispeed F7 (YEG-TOE-S616-55.1-OY), Varispeed E7 (YEG-TOE-S616-56.1-OY), Varispeed G7 (TOE-S616-60.2).

The *SYSMAC Support Software Operation Manuals: Basics* and *C-series PLCs* (W247 and W248) provide descriptions of SSS operations for the 3G3RV-P10ST and other SYSMAC C-series PLCs. The *SYS-MAC-CPT Support Software Quick Start Guide* (W332) and *User Manual* (W333) provide descriptions of ladder diagram operations in the Windows environment. The *CX-Programmer User Manual* (W361) and the *CX-Server User Manual* (W362) provide details of operations for the WS02-CXPC1-E CX-Programmer.

Please read this manual carefully and be sure you understand the information provided before attempting to install and operate the 3G3RV-P10ST.

Section 1 describes the special features and functions of the 3G3RV-P10ST, shows the possible system configurations, and outlines the steps required before operation. Read this section first when using the 3G3RV-P10ST for the first time.

Section 2 provides the technical specifications of the 3G3RV-P10ST and describes the main components of these Units.

Section 3 provides information on installing and wiring a 3G3RV-P10ST. Be sure to follow the directions and precautions in this section when installing the 3G3RV-P10ST in a panel or cabinet, wiring the power supply, or wiring I/O.

Section 4 describes the PLC setup for the communication ports, the counter and pulse-output functionality

Section 5 explains the interface with the F7Z/E7Z/L7Z/G7C Inverter.

Section 6 explains exchanging data with CompoBus/S slaves.

Section 7 explains exchanging data with DeviceNet masters.

Section 8 explains the high-speed Encoder interface.

Appendix A provides the instruction set.

Appendix B provides examples.

⚠ **WARNING**	Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety, and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

PRECAUTIONS

This section provides general precautions for using the Programmable Controller (PLC) and related devices.

The information contained in this section is important for the safe and reliable application of the Programmable Controller. You must read this section and understand the information contained before attempting to set up or operate a PLC system.

1 Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of installing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of managing FA systems and facilities.

2 General Precautions

The user must operate the product according to the performance specifications described in the operation manuals.

Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

Make sure that the ratings and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

This manual provides information for installing and operating OMRON-YASKAWA F7 Inverter PLC Option Units. Be sure to read this manual before operation and keep this manual close at hand for reference during operation.

⚠ **WARNING** It is extremely important that a PLC, and all PLC Units, be used for the specified purpose and under the specified conditions, especially in applications that can directly or indirectly affect human life. You must consult with your OMRON representative before applying a PLC system to the above mentioned applications.

Observe the following precautions when using the OMRON-YASKAWA Inverters and peripheral devices.

This manual may include illustrations of the product with protective covers removed in order to describe the components of the product in detail. Make sure that these protective covers are on the product before use.

Consult your OMRON representative when using the product after a long period of storage.

⚠ **WARNING** Do not touch the inside of the Inverter. Doing so may result in electrical shock.

⚠ **WARNING** Operation, maintenance, or inspection must be performed after turning OFF the power supply of the Inverter, confirming that the CHARGE indicator (or status indicators) are OFF, and after waiting for the time specified on the front cover. Not doing so may result in electrical shock.

⚠ **WARNING** Do not damage, pull on, apply stress to, place heavy objects on, or pinch the cables. Doing so may result in electrical shock.

⚠ **WARNING** Do not touch the rotating parts of the motor under operation. Doing so may result in injury.

⚠ **WARNING** Do not modify the product. Doing so may result in injury or damage to the product.

⚠ **Caution** Do not store, install, or operate the product in the following places. Doing so may result in electrical shock, fire or damage to the product.

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to exposure to combustibles.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.

⚠ **Caution** Do not touch the Inverter radiator, regenerative resistor, or motor while the power is being supplied or soon after the power is turned OFF. Doing so may result in a skin burn due to the hot surface.

⚠ **Caution** Do not conduct a dielectric strength test on any part of the Inverter. Doing so may result in damage to the product or malfunction.

⚠ **Caution** Take appropriate and sufficient countermeasures when installing systems in the following locations. Not doing so may result in equipment damage.

- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields and magnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

3 Safety Precautions

⚠ **WARNING** The Unit refreshes I/O even when the program is stopped (i.e., even in PROGRAM mode). Confirm safety thoroughly in advance before changing the status of any part of memory allocated to I/O or the Inverter. Any changes to the data allocated to any of these may result in unexpected operation of the loads connected to the Unit or Inverter. Any of the following operation may result in changes to memory status.

- Transferring I/O memory data from a Programming Device to the Unit.
- Changing present values in memory with a Programming Device.
- Force-setting/-resetting bits with a Programming Device.
- Transferring I/O memory from a host computer or from another PLC on a network.

⚠ **WARNING** Do not attempt to take any Unit apart while the power is being supplied. Doing so may result in electric shock.

⚠ **WARNING** Do not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.

⚠ **WARNING** Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

⚠ **Caution** Execute online edit only after confirming that no adverse effects will be caused by extending the cycle time. Otherwise, the input signals may not be readable.

⚠ **Caution** Confirm safety at the destination node before transferring a program to another node or changing contents of the I/O memory area. Doing either of these without confirming safety may result in injury.

4 Maintenance and Inspection Precautions

⚠ **WARNING** Do not touch the Inverter terminals while the power is being supplied.

⚠ **WARNING** Maintenance or inspection must be performed only after turning OFF the power supply of the Inverter, confirming that the CHARGE indicator (or status indicators) is turned OFF, and after waiting for the time specified on the front cover. Not doing so may result in electrical shock.

⚠ **WARNING** Maintenance, inspection, or parts replacement must be performed by authorized personnel. Not doing so may result in electrical shock or injury.

⚠ **WARNING** Do not attempt to take the Unit apart or repair. Doing either of these may result in electrical shock or injury.

⚠ **Caution** Carefully handle the Inverter because it uses semiconductor elements. Careless handling may result in malfunction.

⚠ **Caution** Do not change wiring, disconnect connectors or Operator, or replace fans while power is being supplied. Doing so may result in injury or malfunction.

⚠ **Caution** Be sure to wire correctly and securely. Not doing so may result in injury or damage to the product.

5 Operation and Adjustment Precautions

⚠ **WARNING** Turn ON the input power supply of the Inverter only after mounting the front cover, terminal covers, bottom cover, Operator, and optional items. Not doing so may result in electrical shock.

⚠ **WARNING** Do not remove the front cover, terminal covers or optional items while the power is being supplied. Not doing so may result in electrical shock.

⚠ **WARNING** Do not operate the Operator or switches with wet hands. Doing so may result in electrical shock.

⚠ **WARNING** Do not touch the inside of the Inverter. Doing so may result in electrical shock.

⚠ **WARNING** Provide a separate emergency stop switch because the STOP Key on the Operator is valid only when function settings are performed. Not doing so

may result in injury.

6 Wiring Precautions

⚠ **WARNING** Wiring must be performed only after confirming that the power supply of the Inverter has been turned OFF. Not doing so may result in electrical shock.

⚠ **WARNING** Wiring must be performed by authorized personnel. Not doing so may result in electrical shock or fire.

7 Application Precautions

Observe the following precautions when using the PLC Unit.

⚠ **WARNING** Failure to abide by the following precautions could lead to serious or possibly fatal injury. Always heed these precautions.

- Always ground the system with 100 Ω or less when installing the system, to protect against electrical shock.
- Always turn off the power supply of the Inverter before attempting any of the following. Performing any of the following with the power supply turned on may lead to electrical shock:
  - Assembling any devices or racks.
  - Connecting or disconnecting any connectors, cables or wiring.
  - Setting DIP switches or rotary switches.

⚠ **WARNING** Failure to abide by the following precautions could lead to faulty operation of the PLC or the system, or could damage the PLC or PLC Units. Always heed these precautions.

- Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.
- Interlock circuits, limit circuits, and similar safety measures in external circuits (i.e., not in the Programmable Controller) must be provided by the customer.
- Use the Units only with the power supplies and voltages specified in the operation manuals. Other power supplies and voltages may damage the Units.
- Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.
- Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.
- Do not apply voltages exceeding the rated input voltage to Input Units. The Input Units may be destroyed.
- Do not apply voltages exceeding the maximum switching capacity to Output Units. The Output Units may be destroyed.

⚠ **Caution**

- Install the Units properly as specified in the operation manuals. Improper installation of the Units may result in malfunction.
- Wire all connections correctly. Double-check all wiring and switch settings before turning on the power supply. Incorrect wiring may result in burning.
- Mount Units only after checking terminal blocks and connectors completely.
- Be sure that the terminal blocks, Memory Units, expansion cables, and other items with locking devices are properly locked into place. Improper locking may result in malfunction.
- Check switch settings, the contents of the DM Area, and other preparations before starting operation. Starting operation without the proper settings or data may result in an unexpected operation.
- Check the user program for proper execution before actually running it on the Unit. Not checking the program may result in an unexpected operation.
- Confirm that no adverse effect will occur in the system before attempting any of the following. Not doing so may result in an unexpected operation.
    - Changing the operating mode of the PLC.
    - Force-setting/force-resetting any bit in memory.
    - Changing the present value of any word or any set value in memory.
- Resume operation with a new CPU Unit only after transferring the contents of the DM Area, HR Area, and other data required for resuming operation to the new Unit. Not doing so may result in an unexpected operation.
- Do not pull on the cables or bend the cables beyond their natural limit. Doing either of these may break the cables.
- Do not place objects on top of the cables or other wiring lines. Doing so may break the cables.
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static built-up. Not doing so may result in malfunction or damage.
- Do not touch circuit boards or the components mounted to them with your bare hands. There are sharp leads and other parts on the boards that may cause injury if handled improperly.
- Do not attempt to take any Units apart, to repair any Units, or to modify any Units in any way.

8 EC Directives

8-1 Applicable Directives

- EMC Directives
- Low Voltage Directive

8-2 Concepts

EMC Directives

OMRON devices that comply with EC Directives also conform to the related EMC standards so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC standards (see the following note). Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer.

EMC-related performance of the OMRON devices that comply with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

Note Applicable EMC (Electromagnetic Compatibility) standards are as follows:

EMS (Electromagnetic Susceptibility): EN61800-3

EMI (Electromagnetic Interference): EN50081-2/EN55011

(Radiated emission: 10-m regulations)

Low Voltage Directive

Safety standard: EN50178: 1997

8-3 Conformance to EC Directives

The 3G3RV-P10ST series products comply with EC Directives. To ensure that the machine or device in which the PLC is used complies with EC Directives, the PLC must be installed as follows:

1, 2, 3...

1. The PLC must be installed within a control panel.
2. You must use reinforced insulation or double insulation for the DC power supplies used for the communications power supply and I/O power supplies.
3. OMRON PLCs complying with EC Directives also conform to the Common Emission Standard (EN50081-2). Radiated emission characteristics (10-m regulations) may vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions. You must therefore confirm that the overall machine or equipment complies with EC Directives.

SECTION 1
Introduction

This section describes the special features and functions of the 3G3RV-P10ST, shows the possible system configurations, and outlines the steps required before operation. Read this section first when using the 3G3RV-P10ST for the first time. Refer to the *CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353) for details on programming operations.

1-1 3G3RV-P10ST Features and Functions

1-1-1 3G3RV-P10ST Features

The 3G3RV-P10ST PLC Option Units are compact CPM2C PLCs that have been equipped with an F7Z/E7Z/L7Z/G7C-Inverter interface. The 3G3RV-P10ST incorporates a variety of special features just like the CPM2C, including synchronized pulse control, interrupt inputs, pulse outputs, and a clock function.

- The Inverter interface reduces wiring, and saves space. Instead of using a CPM2C with CIF11 to communicate to an F7-Inverter, the P10SDT communicates directly to the Inverter without the overhead.
- The 3G3RV-P10ST itself can handle a wide range of machine control applications. In addition, the 3G3RV-P10ST is capable of communications with devices such as personal computers and OMRON Programmable Terminals so it is ideal to use to expand or upgrade existing systems.
- The 3G3RV-P10ST CPU Unit has a total of 10 I/O points: 6 inputs and 4 transistor outputs.
- The 3G3RV-P10ST has a dedicated Encoder interface, capable of reading positions of encoders with a maximum frequency input of 50kHz.
- The communications port can be used simultaneously as two ports: Peripheral and RS-232C. The peripheral port supports Programming Devices, Host Link, and no-protocol communications. The RS-232C port supports Host Link, no-protocol (serial), 1:1 PLC Link, and 1:1 NT Link communications.
- Included is also an RS-422/485 interface which allows for a cheap connection to other 3G3RV-P10ST's, other Inverters, NT-terminals, etc.
- Extra I/O can be created by connecting CompoBus/S-slaves to the 3G3RV-P10ST.
- The 3G3RV-P10ST-DRT version also includes a DeviceNet slave interface, allowing it to be connected to a DeviceNet master.

Loss of Inverter functionality

Whenever the 3G3RV-P10ST is attached to an F7 Inverter, the following functionality of the Inverter is lost:

- MEMOBUS communication through the RS-422/485 interface of the Inverter is disabled. The MEMOBUS communication through the RJ-45 connector is still available.

1-1-2 Overview of 3G3RV-P10ST Functions

<table>
<tr><th>Main function</th><th colspan="2">Variations/Details</th></tr>
<tr><td>Inverter interface</td><td colspan="2">Direct interface with E7/F7/L7/G7 Inverter through
• IR-memory
• DM-memory
• Transfer command</td></tr>
<tr><td>CompoBus/S Master functions</td><td colspan="2">• Remote I/O devices can be allocated up to 256 I/O points (128 inputs and 128 outputs) in input area IR 020 to IR 027 and output area IR 030 to IR 037.
• The node numbers can be set to 0 to 7 (128-point mode) or 0 to 15 (256-point mode).
• The communications mode can be set to high-speed mode (max. length 100 m) or long-distance mode (max. length 500 m).</td></tr>
<tr><td>DeviceNet Slave functions</td><td colspan="2">• Up to 64 words (32 input words and 32 output words) can be allocated to the DeviceNet Master’s I/O. The Master’s I/O can be allocated to the following data areas.
IR 000 to IR 049
IR 200 to IR 227
DM 0000 to DM 2047
LR 00 to LR 15
HR 00 to HR 19
AR 00 to AR 23 (3G3RV-P10ST → Master; read-only)
TC 000 to TC 255
• Explicit message communications are supported. Any 3G3RV-P10ST data area can be accessed from the DeviceNet Master.
• The communications speed can be set to 500 kbps (total network length 100 m max.), 250 kbps (total network length 250 m max.), or 125 kbps (total network length 500 m max.).</td></tr>
<tr><td rowspan="3">Interrupts</td><td colspan="2">Interrupt inputs
2 inputs
Response time: 50 μs</td></tr>
<tr><td>Interval timer interrupts
1 input
Set value: 0.5 to 319,968 ms
Precision: 0.1 ms</td><td>Scheduled interrupts

One-shot interrupt</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="3">High-speed counters</td><td rowspan="2">High-speed counter
1 input, see note 1.
Differential phase mode (5 kHz)
Pulse plus direction input mode (20 kHz)
Up/down input mode (20 kHz)
Increment mode (20 kHz)</td><td>No interrupt</td></tr>
<tr><td>Count-check interrupt
(An interrupt can be generated when the count equals the set value or the count lies within a preset range.)</td></tr>
<tr><td rowspan="2">Interrupt inputs (counter mode)
2 inputs
Incrementing counter (2 kHz)
Decrementing counter (2 kHz)</td><td>No interrupt</td></tr>
<tr><td>Count-up interrupt</td></tr>
<tr><td>Pulse outputs</td><td colspan="2">• 2 outputs:
Single-phase pulse output without acceleration/deceleration (See note 2.)
10 Hz to 10 kHz
• 2 outputs:
Variable duty ratio pulse output (See note 2.)
0.1 to 999.9 Hz, duty ratio 0 to 100%
• 1 output:
Pulse output with trapezoidal acceleration/deceleration (See note 2.)
Pulse plus direction output, up/down pulse output, 10 Hz to 10 kHz</td></tr>
</table>

Main function	Variations/Details
Synchronized pulse control	1 point, see notes 1 and 2. Input frequency range: 10 to 500 Hz, 20 Hz to 1 kHz, or 300 Hz to 20 kHz Output frequency range: 10 Hz to 10 kHz
Quick-response input	2 inputs Minimum input signal width: 50 μs
Input time constant	Determines the input time constant for all inputs. (Settings: 1, 2, 3, 5, 10, 20, 40, or 80 ms)
Calendar/Clock	Shows the current year, month, day of the week, day of the month, hour, minute, and second.
Encoder interface	3 input modes: Differential-phase (up/down) Pulse plus direction Up/down pulse Maximum input frequency 50 kHz Maximum counter range 4,294,967,295 (2^{32}-1) Two capture registers, 3 selectable registration inputs One comparison value Counter reset through software or Z-phase Interrupt function

Note 1. This input is shared by the high-speed counter and synchronized pulse control functions.

2. This output is shared by the pulse output and synchronized pulse control functions.

1-2 System Configurations

1-2-1 Unit types

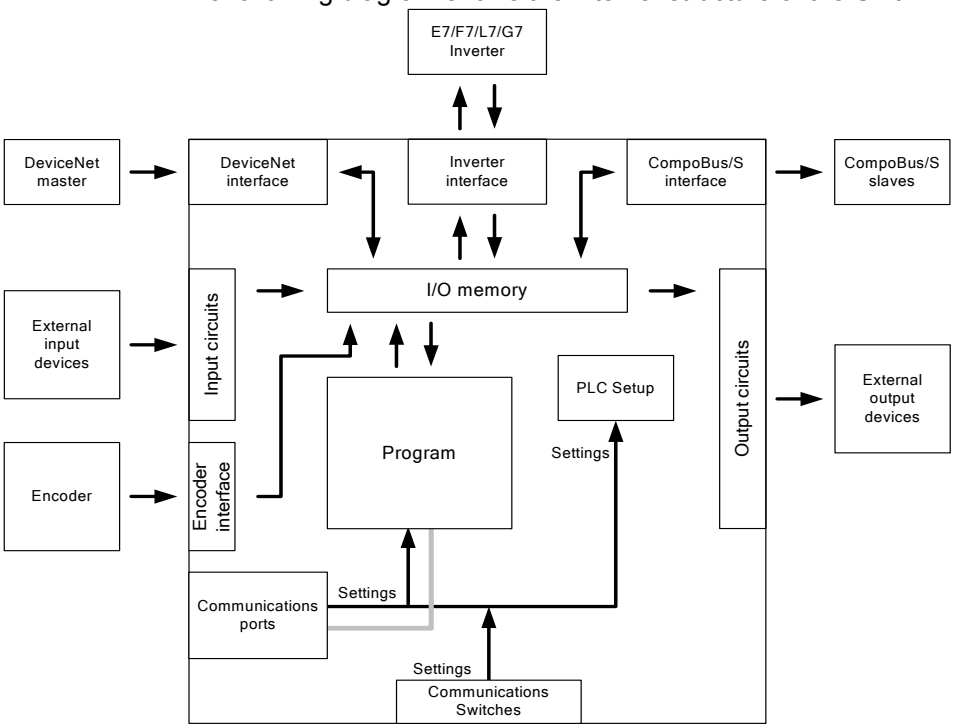
3G3RV-P10ST Units

Item	3G3RV-P10ST8-E	3G3RV-P10ST8-DRT-E
PLC core	CPM2C-S	CPM2C-S
Inputs	6 24 VDC inputs	6 24 VDC inputs
Outputs	4 sourcing transistor outputs	4 sourcing transistor outputs
Peripheral port	Yes	Yes
RS-232C port	Yes	Yes
RS-422/485 port	Yes	Yes
Calendar/Clock	Yes	Yes
Memory backup	Flash memory and battery	Flash memory and battery
CompoBus/S master interface	Yes	Yes
Encoder interface	Yes	Yes
DeviceNet slave interface	No	Yes

1-3 3G3RV-P10ST Structure and Operation

1-3-1 3G3RV-P10ST Structure

The following diagram shows the internal structure of the Unit.



I/O Memory

The program reads and writes data in this memory area during execution. Part of the I/O memory contains the bits that reflect the status of the PLC's inputs and outputs. Parts of the I/O memory are cleared when the power is turned ON and other parts are retained.

Program

This is the program written by the user. The 3G3RV-P10ST executes the program cyclically. (Refer to section *1-3-4 Cyclic Operation and Interrupts* for details.) The program can be divided broadly into two parts: the "main program" that is executed cyclically and the "interrupt programs" that are executed only when the corresponding interrupt is generated.

PLC Setup

The PLC Setup contains various startup and operating parameters. The PLC Setup parameters can be changed from a Programming Device only; they cannot be changed from the program.

Some parameters are accessed only when PLC's power supply is turned ON and others are accessed regularly while the power is ON. It will be necessary to turn the power OFF and then ON again to enable a new setting if the parameter is accessed only when the power is turned ON.

Note Refer to *4-1 PLC-setup* for details on the PLC Setup.

Communications Switches

The Communications Switches determine whether the peripheral port and RS-232C port connected through the communications port operate with the standard communications settings or the communications settings in the PLC Setup.

Inverter Interface

The PLC core communicates to the Inverter through IR-, DM-memory, either by direct mapping or through the Transfer command.

Note Refer to *section 5-4 Transfer command* for more details.

1-3-2 Operating Modes

3G3RV-P10ST Units have 3 operating modes: PROGRAM, MONITOR, and RUN.

PROGRAM Mode

The program cannot be executed in PROGRAM mode. This mode is used to perform the following operations in preparation for program execution.

- Changing initial/operating parameters such as those in the PLC Setup
- Writing, transferring, or checking the program
- Checking wiring by force-setting and force-resetting I/O bits

⚠ **Caution** The PLC continues to refresh I/O bits even if the PLC is in PROGRAM mode, so devices connected to output points may operate unexpectedly if the corresponding output bit is turned ON by transferring I/O memory or force-setting output bits from a Programming Device.

MONITOR Mode

The program is executed in MONITOR mode and the following operations can be performed from a Programming Device. In general, MONITOR mode is used to debug the program, test operation, and make adjustments.

- Online editing
- Monitoring I/O memory during operation
- Force-setting/force-resetting I/O bits, changing set values, and changing present values during operation

RUN Mode

The program is executed at normal speed in RUN mode. Operations such as online editing, force-setting/force-resetting I/O bits, and changing set values/present values cannot be performed in RUN mode, but the status of I/O bits can be monitored.

1-3-3 Operating Mode at Startup

The operating mode of the 3G3RV-P10ST when the power is turned ON depends upon the setting of pin 2 on the DIP switch on the front of the 3G3RV-P10ST, the PLC Setup settings in DM 6600, and the Programming Console's mode switch setting if a Programming Console is connected.

PLC Setup setting			Operating mode
Word	**Bits**	**Setting**	
DM 6600	08 to 15	00 (Hex)	See note 1.
		01 (Hex)	Startup mode is the same as the operating mode before power was interrupted.
		02 (Hex)	Startup mode is determined by bits 00 to 07.
	00 to 07	00 (Hex)	PROGRAM mode
		01 (Hex)	MONITOR mode
		02 (Hex)	RUN mode

Note 1. The operating mode at startup depends upon the setting of DIP switch pin 2 and the Programming Device connected to the communications port (peripheral port).

Programming Device	Pin 2 OFF	Pin 2 ON
None	PROGRAM mode	RUN mode
Programming Console	Operating mode set on the Programming Console's mode switch	
Other device	PROGRAM mode	

The default setting for bits 08 to 15 of DM 6600 is 00. If this default setting is used and pin 2 is OFF, the 3G3RV-P10ST will automatically start operating in RUN mode when the power is turned ON.

Note 2. If pin 2 is OFF and only an RS-232C cable is connected to the communications port (i.e., there is no peripheral port connection), the 3G3RV-P10ST will automatically start operating in RUN mode when the power is turned ON.
Example Cable Connections:
CS1W-CN118 and XW2Z-200S/500S
CS1W-CN118 and XW2Z-200S-V/500S-V
CPM2C-CN111 and XW2Z-200S/500S (no peripheral port connection)
CPM2C-CN111 and XW2Z-200S-V/500S-V (no peripheral port connection)

1-3-4 Cyclic Operation and Interrupts

Basic CPU Operation

Initialisation processing is performed when the power is turned on. If there are no initialisation errors, the overseeing processes, program execution, I/O refreshing, and communications port servicing are performed repeatedly (cyclically).

Startup initialisation	• Check hardware. • Check memory. • Read data from flash memory (program, read-only DM data, and PLC Setup settings).
Inverter interface initial Processing	• Inverter Interface initial processing
Overseeing processes	• Check for battery error. • Preset the watch (maximum) cycle time. • Check program memory. • Refresh bits for expansion functions.
CompoBus/S input refreshing	• Read input data from CompoBus/S remote I/O Slaves.
Inverter input refreshing	• Inverter Interface status refresh
Program execution	• Execute the program. (Refer to the Programming Manual (W353) for details on cycle time and I/O response times.)
Cycle time calculation	• Wait for minimum cycle time if a minimum cycle time has been set in the PC Setup (DM 6619). • Calculate cycle time.
CompoBus/S output refreshing	• Write output data to CompoBus/S remote I/O Slaves.
I/O refreshing	• Read input data from input bits. • Write output data to output bits.
DeviceNet I/O refreshing	• Exchange I/O data with the DeviceNet Master. (-DRT versions only)
Inverter output refreshing	• Inverter Interface control data refresh
Inverter Modbus transfer	• Inverter Interface Modbus command execution • When Inverter processing is ended by END refresh timing, a maximum of eight data items are read or written. If the Inverter is currently processing, nothing will be done and it will be checked with the next scan.
DeviceNet message communications	• Perform explicit message communications with the DeviceNet Master. (-DRT versions only)
RS-232C port servicing	• Perform RS-232C port communications processing. (Can be changed in DM 6616.)
Peripheral port servicing	• Perform peripheral port communications processing. (Can be changed in DM 6617.)

The cycle time can be read from a Programming Device.
AR 14 contains the maximum cycle time and AR15 contains the present cycle time in multiples of 0.1 ms.

1-4 Comparison with the CPM2C-S

Item			CPM2C-S	3G3RV-P10ST
Instruction set	Basic instructions		14	14
	Special instructions		105 instructions, 185 variations	105 instructions, 185 variations
Instruction execution times	Basic instructions		LD: 0.64 μs	LD: 0.64 μs
	Special instructions		MOV(21): 7.8 μs	MOV(21): 7.8 μs
Program capacity			4,096 words	4,096 words
Maximum number of I/O points	Stand-alone CPU Unit		10 points	10 points
	CPU Unit with Expansion I/O Units		362 points max.	---
Expansion Units and Expansion I/O Units	Maximum number of Units		A maximum of 3 Units.	---
	Available models		Expansion I/O Units, Analog I/O Unit, Temperature Sensor Unit, and CompoBus/S I/O Link Unit	---
I/O memory	Input bits		IR 00000 to IR 00915	IR 00000 to IR 00915
	Output bits		IR 01000 to IR 01915	IR 01000 to IR 01915
	Work bits		672 bits: IR 02800 to IR 02915, IR 03800 to IR 04915, IR 20000 to IR 22715	448 bits: IR 02800 to IR 02815 IR 03800 to IR 04715 IR 21100 to IR 22715
	SR (Special Relay) area		448 bits: SR 22800 to SR 25515	448 bits: SR 22800 to SR 25515
	TR (Temporary Relay) area		8 bits: TR0 to TR7	8 bits: TR0 to TR7
	HR (Holding Relay) area		320 bits: HR 0000 to HR 1915	320 bits: HR 0000 to HR 1915
	AR (Auxiliary Relay) area		384 bits: AR 0000 to AR 2315	384 bits: AR 0000 to AR 2315
	LR (Link Relay) area		256 bits: LR 0000 to LR 1515	256 bits: LR 0000 to LR 1515
	Timer/Counter area		256 bits: TIM/CNT 000 to TIM/CNT 255	256 bits: TIM/CNT 000 to TIM/CNT 255
	DM (Data Memory) area	Read/write area	2,022 words: DM 0000 to DM 2021	1,993 words: DM 0000 to DM 1985 DM 2041 to DM 2047
		Read-only area	456 words: DM 6144 to DM 6599	456 words: DM 6144 to DM 6599
		PLC Setup	56 words: DM 6600 to DM 6655	56 words: DM 6600 to DM 6655
	Inverter Interface		---	176 bits: IR 20000 to IR 21015 19 words: DM 2022 to DM 2040
	Encoder interface		---	48 bits: IR 02900 to 02915 IR 04800 to 04915 14 words: DM 1986 to DM 1999

Item		CPM2C-S	3G3RV-P10ST
Memory backup	Program area, read-only DM area (including PLC Setup)	Flash memory backup	Flash memory backup
	Read/write DM area, HR area, AR area, and counters	Internal battery backup (2-year life-time at 25°C, replaceable)	Internal battery backup (5-year lifetime at 25°C, replaceable)
CompoBus/S Master Functions		Up to 32 Slaves can be connected and up to 256 I/O points can be controlled.	Up to 32 Slaves can be connected and up to 256 I/O points can be controlled.
DeviceNet Slave Functions		DeviceNet Remote I/O Link Use up to 1,024 I/O points in the I/O Link. Explicit Message Communications Any PLC data area can be accessed from the Master.	DeviceNet Remote I/O Link Use up to 1,024 I/O points in the I/O Link. Explicit Message Communications Any PLC data area can be accessed from the Master.
Interrupt inputs (interrupt input mode)		2	2
Interrupt inputs (counter mode)	Counter mode	Incrementing counter Decrementing counter	Incrementing counter Decrementing counter
	Counter upper limit	2 kHz	2 kHz
	SR 244 to SR 247	Contains counter PV.	Contains counter PV.
	Method(s) to read counter PV	Read SR 244 to SR247. Execute PRV(62).	Read SR 244 to SR247. Execute PRV(62).
	Method to change counter PV	Execute INI(61).	Execute INI(61).
Interval timer	One-shot mode	Yes	Yes
	Scheduled interrupt mode	Yes	Yes
Quick-response inputs	Setting the quick-response function	PLC Setup	PLC Setup
	INT(89) (Mask)	Not supported (ignored)	Not supported (ignored)
	INT(89) (Read mask)	Reads mask status.	Reads mask status.
	INT(89) (Clear)	Not supported (ignored)	Not supported (ignored)
	Minimum pulse width	50 μs min.	50 μs min.
High-speed counter	Count mode	Differential-phase (up/down) mode Pulse plus direction mode Up/down pulse mode Increment mode	Differential-phase (up/down) mode Pulse plus direction mode Up/down pulse mode Increment mode
	Max. counter frequency	5 kHz in differential-phase (up/down) mode 20 kHz in pulse plus direction mode, up/down pulse mode, and increment mode	5 kHz in differential-phase (up/down) mode 20 kHz in pulse plus direction mode, up/down pulse mode, and increment mode
	Counter PV range	–8,388,608 to 8,388,607 in differential-phase (up/down) mode, pulse plus direction mode, and up/down pulse mode 0 to 16,777,215 in increment mode	–8,388,608 to 8,388,607 in differential-phase (up/down) mode, pulse plus direction mode, and up/down pulse mode 0 to 16,777,215 in increment mode
	Check when registering target value match table	Same direction, same SV not possible	Same direction, same SV not possible

Item		CPM2C-S	3G3RV-P10ST
High-speed counter (continued)	Method used to reference the target value match interrupt table	Comparison of all values in the table, regardless of order of appearance in table	Comparison of all values in the table, regardless of order of appearance in table
	Reading range-comparison results	Check AR 1100 to AR1107 or execute PRV(62).	Check AR 1100 to AR1107 or execute PRV(62).
	Reading status	Check AR 1108 (comparison in progress), check AR1109 (high-speed counter PV overflow/underflow), or execute PRV(62).	Check AR 1108 (comparison in progress), check AR1109 (high-speed counter PV overflow/underflow), or execute PRV(62).
Pulse synchronization		Supported.	Supported.
Pulse output control	Trapezoidal acceleration/ deceleration	Supported with ACC(—). The initial frequency can be set.	Supported with ACC(—). The initial frequency can be set.
	PWM(—) output	Supported.	Supported.
	Number of simultaneous pulse outputs	2 max.	2 max.
	Maximum frequency	10 kHz max.	10 kHz max.
	Minimum frequency	10 Hz	10 Hz
	Pulse output quantity	–16,777,215 to 16,777,215	–16,777,215 to 16,777,215
	Direction control	Supported.	Supported.
	Positioning to absolute positions	Supported.	Supported.
	Bit status while pulses are being output	No effect	No effect
	Reading PV	Read SR 228 through SR231 or execute PRV(62).	Read SR 228 through SR231 or execute PRV(62).
	Resetting PV	Supported.	Supported.
	Status outputs	Accelerating/decelerating PV overflow/underflow Pulse quantity set Pulse output completed Pulse output status	Accelerating/decelerating PV overflow/underflow Pulse quantity set Pulse output completed Pulse output status
Clock function		Internal	Internal
	Words containing time info.	AR 17 to AR 21	AR 17 to AR 21
Communications switch		This switch determines whether communications are governed by the standard settings or PLC Setup settings. Also sets the Programming Device connection.	This switch determines whether communications are governed by the standard settings or PLC Setup settings. Also sets the Programming Device connection.
Battery	Battery	Internal lithium battery backup	Internal lithium battery backup
	Battery replacement	Possible	Possible
	Life expectancy/backup time	2-year lifetime at 25°C	5-year lifetime at 25°C
	Battery error detection	Supported.	Supported.

Item		CPM2C-S	3G3RV-P10ST
Communications (in CPU Unit)	Peripheral port (via communications port)	Programming Console (Set with Communications Switch.) Peripheral bus (Set with Communications Switch.) Host Link (with Slave-initiated communications) No-protocol	Programming Console (Set with Communications Switch.) Peripheral bus (Set with Communications Switch.) Host Link (with Slave-initiated communications) No-protocol
	RS-232C port (via communications port)	Peripheral bus (Set with Communications Switch.) Host Link No-protocol 1:1 PLC LInk 1:1 NT Link	Peripheral bus (Set with Communications Switch.) Host Link No-protocol 1:1 PLC LInk 1:1 NT Link
	RS-422 port	Through CIF-unit	Peripheral bus Host Link (with Slave-initiated communications) No-protocol
Input time constant		Can be set to 1, 2, 3, 5, 10, 20, 40, or 80 ms. (Default: 10 ms)	Can be set to 1, 2, 3, 5, 10, 20, 40, or 80 ms. (Default: 10 ms)
Encoder interface	Count mode	---	Differential-phase (up/down) mode Pulse plus direction mode Up/down pulse mode
	Max. counter frequency		50 kHz
	Counter range		0 to 4,294,967,295 (2^{32}-1) or user defined upper-limit
	Capturing		Two capture registers Inputs 00004, 00005, Phase-Z input
	Comparison		One comparison value
	Counter reset		Through software or Phase-Z input
	Interrupt function		Generated at programmable event: Capturing, Under-, Overflow, Comparison

Differences in I/O Memory

IR Area Differences

Function	CPM2C-S	3G3RV-P10ST
Work bits	672 bits: IR 028 to IR 029 IR 038 to IR 049 IR 200 to IR 227	448 bits: IR 028 IR 038 to IR 047 IR 211 to IR 227
Inverter Interface		176 bits: IR 200 to IR 210
Encoder interface		48 bits: IR 029 IR 048 to 049

DM Area Differences

Function	CPM2C-S	3G3RV-P10ST
Inverter Interface		19 words: DM 2022 to DM 2040
Encoder interface		14 words: DM 1986 to DM 1999

1-5 Preparation for Operation

Follow the steps listed below when setting up a 3G3RV-P10ST system.

1, 2, 3...

1. System Design
   - Select a 3G3RV-P10ST Unit with the specifications required in the controlled system.
   - Design external fail-safe circuits such as interlock circuits and limit circuits.
2. Installation
   - Install the Unit on the Inverter controller board
3. Wiring
   - Wire the Inverter and I/O devices.
   - Connect communications devices if necessary.
   - Connect the Programming Console.
4. Initial Settings
   - Set the Communications Switches on the front of the CPU Unit, if necessary. (The switches must be set when a device other than the Programming Console is connected or the standard communications settings are not used.)
   - Connect the Programming Console, set the mode switch to PROGRAM mode, and turn ON the Inverter.
   - Check the Unit's LED indicators and the Programming Console's display.
   - Clear the PLC's memory. (All Clear)
   - Make PLC Setup settings.
5. Create Ladder Program
   - Create a ladder program to control the system.
6. Write Ladder Program in PLC
   - Write the ladder program in the PLC with the Programming Console or transfer the program to the PLC from the Support Software.
7. Test Run
   - Check I/O wiring in PROGRAM mode.
   - Check and debug program execution in MONITOR mode.

SECTION 2
Unit Components and Specifications

This section provides the technical specifications of the 3G3RV-P10ST Units and describes the main components of these Units.

2-1 Specifications

2-1-1 General Specifications

Item		Specifications	
		3G3RV-P10ST8-E	3G3RV-P10ST8-DRT-E
Rated power supply voltage		24 VDC $^{+10\%}/_{-15\%}$ (External power supply for I/O)	
Communications power supply voltage		---	11 to 25 VDC (supplied by DeviceNet connector)
Power Consumption	Internal power supply	2W (Supplied internally) (see note.)	3W (Supplied internally) (see note.)
	Communications power supply	---	30 mA max.
Vibration resistance		10 to 20 Hz, 9.8 m/s^2 max. 20 to 50 Hz, 2 m/s^2 max	
Ambient operating temperature		-10 to 45 °C	
Ambient operating relative humidity		10% to 90% (no condensation)	
Ambient storage temperature		-20 to 70 °C	
Atmosphere		Must be free from corrosive gas	

Note The above figure for power consumption includes the power consumption of the Programming Console.

2-1-2 Characteristics

Item		Specifications
Control method		Store program method
I/O control method		Cyclic scan method
Programming language		Ladder chart method
Instruction length		1 step/1 instruction; 1 to 5 words/1 instruction
Instruction types	Basic	14 types (Same as for Programmable Slaves.)
	Special	105 types, 185 instructions (Same as for Programmable Slaves.)
Processing speed	Basic instructions	0.64 μs (LD)
	Special instructions	7.8 μs (MOV)
Program capacity		4,096 words
Maximum number of I/O points		10
Input bits		00000 to 00005 (6 physical inputs)
Output bits		01000 to 01003 (4 physical outputs)
CompoBus/S input bits		128 bits: IR 02000 to IR 02715 (Bits not used for CompoBus/S input bits can be used for work bits.)
CompoBus/S output bits		128 bits: IR 03000 to IR 03715 (Bits not used for CompoBus/S output bits can be used for work bits.)
Inverter interface bits		176 bits: IR 20000 to IR 21015
Encoder interface bits		48 bits: IR 02900 to IR 02915 and IR 04800 to IR 04915
Work bits		448 bits: IR 02800 to IR 02815, IR 03800 to IR 04715, and IR 21100 to IR 22715
Special bits (SR area)		448 bits: SR 22800 to SR 25507 (words SR 228 to SR 255)
Temporary bits (TR area)		8 bits (TR 0 to TR 7)

Item		Specifications
Holding bits (HR area)		320 bits: HR 0000 to HR 1915 (words HR 00 to 19)
Auxiliary bits (AR area)		384 bits: AR 0000 AR 2315 (words AR 00 to AR 23)
Link bits (LR area)		256 bits: LR 0000 to LR 1515 (words LR 00 to LR 15)
Timers/Counters		256 timers/counters (TIM/CNT 000 to TIM/CNT 1-ms timers: TMHH(—) 10-ms timers: TIMH(15) 100-ms timers: TIM 1-s/10-s timers: TIML(—) Decrementing counters: CNT Reversible counters: CNTR(12)
CompoBus/S Master functions		Up to 32 Slaves can be connected and up to 256 I/O points can be controlled.
DeviceNet Slave functions		DeviceNet Remote I/O Link Use up to 1,024 I/O points in the I/O Link. Explicit Message Communications Any PLC data area can be accessed from the Master.
DM Area	Read/Write	2,029 words (DM 0000 to DM 0999, DM 1019 to DM 2047) DM 2000 to DM 2021: Error Log Storage Area
	Read only	456 words (DM6144 to 6599)
	Inverter interface	19 words (DM 2022 to DM 2040)
	Encoder interface	14 words (DM 1986 to DM 1999)
	PLC Setup	56 words (DM 6599 to DM 6655)
Interrupt processing	External interrupts	2 bits (Used in common for input interrupt counter mode and high-speed inputs.)
	Scheduled interrupts	1 bit (Scheduled interrupts or one-shot interrupts)
Pulse outputs		2 bits (without acceleration/deceleration; 10 Hz to 10 kHz each; without directional control). Or 1 bit (with trapezoidal acceleration/deceleration; 10 Hz to 10 kHz each; with directional control). Or 2 bits (Variable duty ratio output).
Pulse synchronous control		1 bit A high-speed counter can be combined with pulse output, and the input pulse frequency from the high-speed counter can be multiplied by a fixed factor for pulse output.
Pulse catch inputs		2 bits Minimum pulse input: 50 μs max. Used in common by input interrupts and input interrupt counter mode.
Analog volume		None
Input time constant (ON response time = OFF response time)		Only all inputs can be set. (1 ms / 2 ms / 3 ms / 5 ms / 10 ms / 20 ms / 40 ms / 80 ms)
Clock function		Yes
Communication function		Port 1 = Peripheral and RS-422 Host Link, Peripheral bus, No-protocol, Programming Console Port 2 = RS-232C port: Host Link, no-protocol, 1:1 PLC Link, 1:1 NT Link
Power-interruption hold function		Holds the contents of HR, AR, CNT, and DM Areas.

Item		Specifications
Memory backup (see notes 1 and 2.)		Flash memory: Program, read-only DM area, and PC Setup Memory backup: The read/write DM area, HR area, AR area, and counter values are backed up. (The battery has a 5-year lifetime at 25°C and it is replaceable.)
Self-diagnostic function		CPU errors, memory errors, communications errors, setting errors, battery errors
Program check		No END instruction, program errors (regularly checked during operation)
Connected tools	CX-Programmer	After Version 2.1
	Programming Console	C200H-PRO27, CQM1-PRO01
	SSS	PC98 & PC/AT (SYSMAC Support Software, All version)
	Sysdrive Configurator	Version 2 or higher

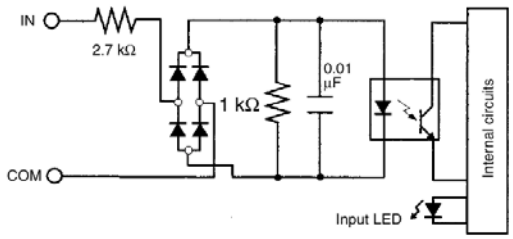
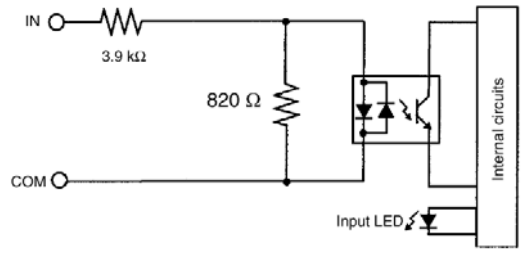
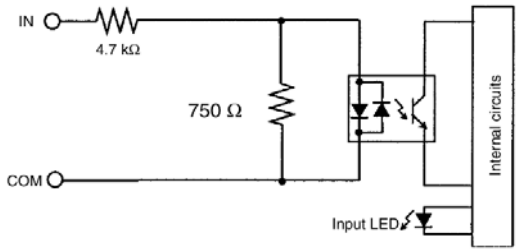
Note 1. The DM area, HR area, AR area, and counter values are backed up. If the backup battery or capacitor is discharged, the contents of these areas will be lost and the data values will revert to the defaults.

2. The contents of the program area, read-only DM area (DM6144 to DM6599), and PLC Setup (DM 6600 to DM 6655) are stored in Flash memory. The contents of these areas will be read from Flash memory the next time the power is turned ON, even if the backup battery or capacitor is discharged.
When data has been changed in any of these areas, write the new values to Flash memory by switching the 3G3RV-P10ST to MONITOR or RUN mode, or by turning the power OFF and then ON again.

3. Changes made while in MONITOR mode using, for example, online editing, are written to Flash memory in real-time.

2-1-3 I/O Specifications

2-1-3-1 Input Specifications

Item	Inputs	Specification
Input voltage	All	24 VDC $^{+10\%}/_{-15\%}$
Input impedance	00000 to 00001	2.7 kΩ
	00002 to 00004	3.9 kΩ
	00005	4.7 kΩ
Input current	00000 to 00001	8 mA typical
	00002 to 00004	6 mA typical
	00005	5 mA typical
ON voltage/current	00000 to 00001	17 VDC min., 5 mA
	00002 to 00005	14.4 VDC min., 3.5 mA
OFF voltage/current	All	5.0 VDC max., 1.1 mA
ON delay	All	1 to 80 ms max. Default: 10 ms (See note.)
OFF delay	All	1 to 80 ms max. Default: 10 ms (See note.)
Circuit configuration	00000 to 00001	
	00002 to 00004	
	00005	

Note The input time constant can be set to 1, 2, 3, 5, 10, 20, 40, or 80 ms in the PLC Setup.

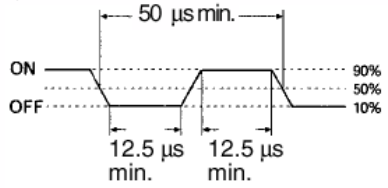
High-speed Counter Inputs

The following Unit input bits can be used as high-speed counter inputs. The maximum count frequency is 5 kHz in differential phase mode and 20 kHz in the other modes.

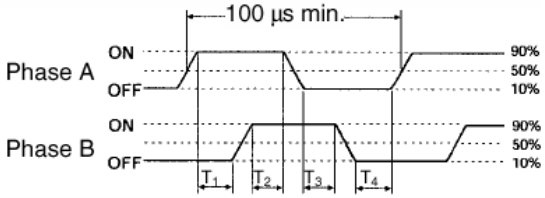
Input	Function			
	Differential phase mode	Pulse plus direction input mode	Up/down input mode	Increment mode
00000	A-phase pulse input	Pulse input	Increment pulse input	Increment pulse input
00001	B-phase pulse input	Direction input	Decrement pulse input	Normal input
00002	Z-phase pulse input or hardware reset input (IN00002 can be used as a normal input when it is not used as a high-speed counter input.)			

The minimum pulse widths for inputs 00000 (A-phase input) and 00001 (B-phase input) are as follows:

Pulse plus direction input mode, Up/down input mode, Increment mode

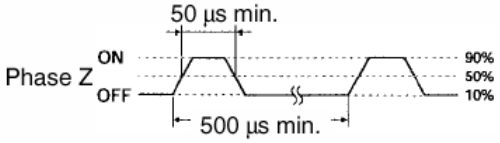


Differential phase mode



$T_1 T_2 T_3 T_4$: 12.5 µs min.

The minimum pulse width for input 00002 (Z-phase input) is as follows:



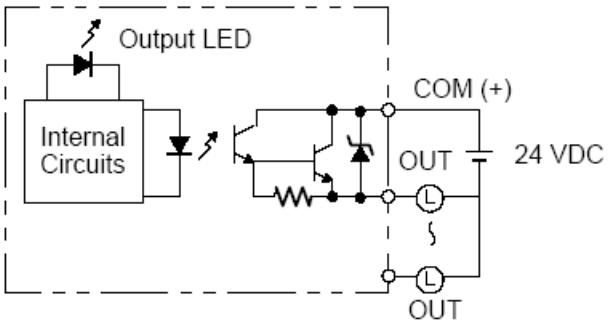
Interrupt Inputs

The 3G3RV-P10ST is equipped with inputs that can be used as interrupt inputs (interrupt input mode or counter mode) and quick-response inputs. The minimum pulse width for these inputs is 50 µs.

Inputs 00003 and 00004 can be used as interrupt inputs.

2-1-3-2 Output Specifications

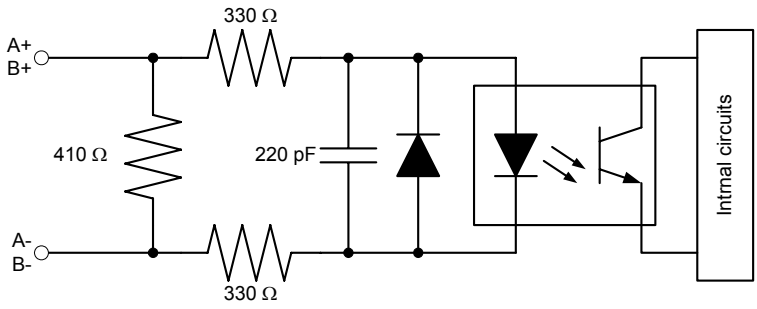
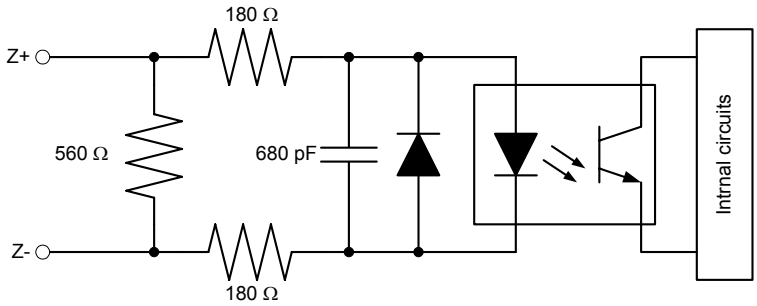
Transistor Outputs (Sourcing)

Item	Specification
Maximum switching capacity	4.5 to 30VDC, 0.2 A/output
Minimum switching capacity	0.5 mA
Maximum inrush current	0.9 A for 10 ms
Leakage current	0.1 mA
Residual voltage	1.5 V max.
ON response time	20 μs max.
OFF response time	40 μs max. for 4.5 to 26.4 VDC, 10 to 100 mA 0.1 ms max for 4.5 to 30 VDC, 10 to 200 mA
Fuse	One fuse per output (cannot be replaced by user)
Circuit configuration	

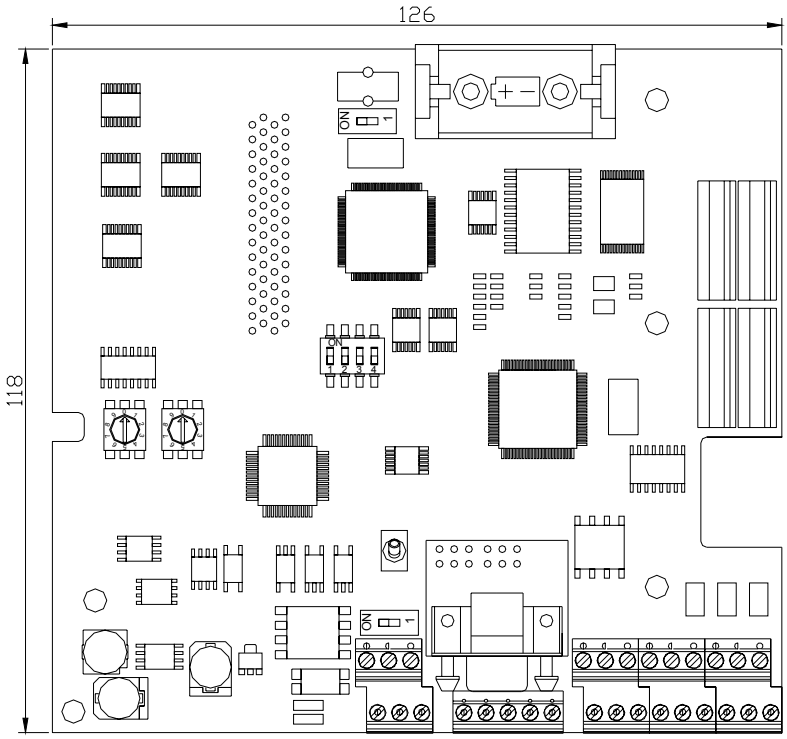
Note 1. When using outputs 01000 or 01001 as a pulse output, connect a dummy resistor as required to bring the load current between 0.01 and 0.1 A. If the load current is below 0.1 A, the ON-to-OFF response time will be longer and high-speed pulses (source-type transistor outputs) will not be output. If the load current is above 0.1 A, the transistor will generate more heat and components may be damaged.

⚠ **Caution** Do not apply voltage in excess of the maximum switching capacity to an output terminal. It may result in damage to the product or fire.

2-1-3-3 Encoder input Specifications

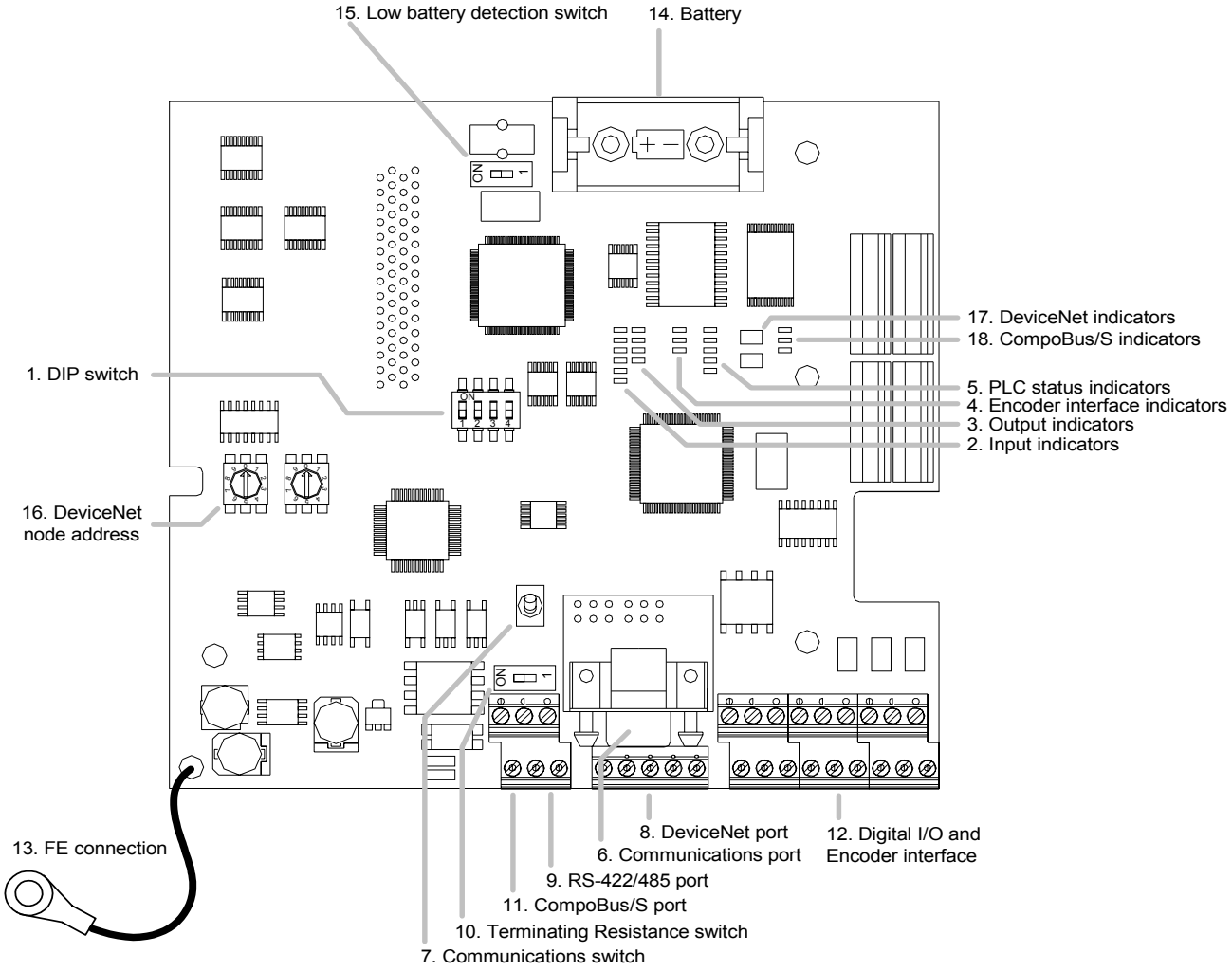
Item	Inputs	Specification
Signal level	All	EIA RS-422-A Standards
Input impedance	A- and B-phase	280 Ω
	Z-phase	260 Ω
Response frequency	A- and B-phase	50 kHz max.
	Z-phase	1 kHz max.
Circuit configuration	A- and B-phase	
	Z-phase	

2-1-4 Dimensions



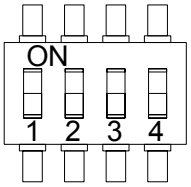
2-2 Unit Components

2-2-1 CPU Unit Component Names



2-2-2 CPU Unit Component Descriptions

1,2,3.. 1. DIP switch



• RS-232C and Peripheral Port Settings

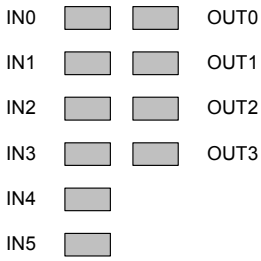
Pin 1	Effective Port Settings
OFF (default)	The ports operate according to the settings in the PLC Setup. RS-232C port settings: DM 6645 to DM 6649 Peripheral/RS-422/485 port settings: DM 6650 to DM 6654
ON	The ports operate with the standard communications settings.

• Operating Mode at Startup

Pin 2 determines the operating mode at startup only if there isn't a Programming Device connected to the peripheral port.

Programming Device connected	Startup mode with pin 2 OFF (default)	Startup mode with pin 2 ON
None	RUN mode	PROGRAM mode
Programming Console	Operating mode set on the Programming Console's mode switch	
Other device	PROGRAM mode	

2. Input indicators (yellow)



The input indicators are lit when the corresponding input terminal is ON. The status of an input indicator will reflect the status of the input even when that input is being used for a high-speed counter.

Note a) When interrupt inputs are used in interrupt input mode, the indicator may not light even when the interrupt condition is met if the input is not ON long enough.

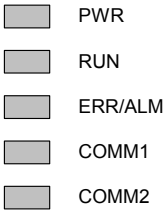
b) Input indicators will reflect the status of the corresponding inputs even when the PLC is stopped, but the corresponding input bits will not be refreshed.

3. Output indicators (yellow)

The output indicators are lit when the corresponding output terminal is ON. The indicators are lit during I/O refreshing. The status of an output indicator will also reflect the status of the corresponding output when the output is being used as a pulse output.

4. Encoder interface indicators (yellow)

The indicators are lit when the corresponding input terminal is ON.



5. PLC status indicators

The following indicators show the operating status of the PLC.

Indicator	Status	Meaning
PWR (green)	ON	Power is being supplied to the unit
	OFF	Power isn't being supplied to the unit
RUN (green)	ON	The PLC is operating in RUN or MONITOR mode
	OFF	The PLC is in PROGRAM mode or a fatal error has occurred.
ERR/ALM (red)	ON	A fatal error has occurred. (PLC operation stops.)
	Flashing	A non-fatal error has occurred. (PLC operation continues.)
	OFF	Indicates normal operation.
COMM1 (yellow)	Flashing	Data is being transferred via the peripheral or RS-422/485 port.
	OFF	Data isn't being transferred via the peripheral or RS-422/485 port.
COMM2 (yellow)	Flashing	Data is being transferred via the RS-232C port
	OFF	Data isn't being transferred via communications port.

6. Communications port

Connects the PLC to a Programming Device (including Programming Consoles), host computer, or standard external device. Use a proper Connecting Cable (CPM2C-CN111, CS1W-CN114, CS1W-CN118, or CS1W-CN226).

Note a) A CQM1H-PRO01-E Programming Console can be connected directly to the PLC.

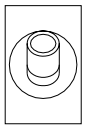
b) A C200H-PRO27-E Programming Console can be connected directly to the PLC with a CS1W-CN224/CN624 Connecting Cable.

c) Use a CPM2C-CN111 or CS1W-CN114 Connecting Cable to connect to the communications port as a peripheral port. The communications port can be used simultaneously as both a peripheral port and RS-232C port by using the CPM2C-CN111 Connecting Cable.

d) Use a CPM2C-CN111, CS1W-CN118 or CS1W-CN226 Connecting Cable to connect to the communications port as a RS-232C port. The communications port can be used simultaneously as both a peripheral port and RS-232C port by using the CPM2C-CN111 Connecting Cable

Note The peripheral port and RS-422/485 port cannot be used simultaneously. When using the peripheral port disconnect any devices connected to the RS-422/485 port.

7. Communications switch



Switch to select port 1 type of connected device

Position	Communication port 1
OFF (up) (default)	Programming Console
ON (down)	RS-422/485 communication

8. DeviceNet port (-DRT versions only)

Terminal Arrangement

V-	CAN-L	Shield	CAN-H	V+

9. RS-422/485 port

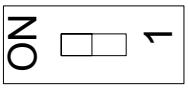
Used to connect to host computers, or standard external devices.

Terminal Arrangement

	Send data (output)	Receive data (input)
6	SDB+	RDB+
5	SDA-	RDA-

Note The maximum line length is 500 m.
The peripheral port and RS-422/485 port cannot be used simultaneously. When using the peripheral port disconnect any devices connected to the RS-422/485 port.
When using RS-485 communication, connect RDA- to SDA- and RDB+ to SDB+.

10. Terminating Resistance switch



Position	Termination
OFF (right) (default)	Disabled
ON (left)	Enabled

Set this switch to ON only for double-ended connection to a Host Link network.

11. CompoBus/S port

Terminal Arrangement

BDH	4	2
BDL	3	1

Use special flat cable or VCTF cable for the transmission lines that connect the nodes in the CompoBus/S I/O Link. (Special flat cables and VCTF cables cannot be combined in the same system.)

Name	Model number	Specifications
Flat cable	XB1T-W10	4-core flat cable, 0.75 mm2
VCTF cable	---	2-core VCTF, 0.75 x 20

12. Digital inputs and outputs and Encoder interface

Connects the CPU Unit to external input and output devices.

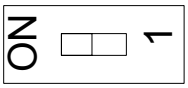
Sourcing outputs

Z-	B-	A-	01003	01001	COM(+)	00005	00003	00001 (B)
Z+	B+	A+	01002	01000	COM	00004	00002 (Z)	00000 (A)

13. Functional Earth-wire

To be connected the earth connection inside the Inverter.

14. Battery



15. Low battery detection switch

This switch enables or disables the detection of a low-battery error.

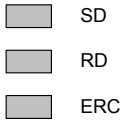
Position	Low-battery detection
OFF (right) (default)	Error detection enabled
ON (left)	Error detection disabled

16. DeviceNet node-number (-DRT versions only)

Please refer to the DeviceNet section (7-1-1 Setting the Node Number)

17. DeviceNet indicators (-DRT versions only)

Please refer to the DeviceNet section (7-4-1 LED Indicators)



18. CompoBus/S indicators

Indicator	Status	Meaning
SD (yellow)	Flashing	Data is being transmitted via CompoBus/S
	OFF	Data isn't being transmitted via CompoBus/S
RD (yellow)	Flashing	Data is being received via CompoBus/S
	OFF	Data isn't being received via CompoBus/S
ERC (red)	Flashing	A CompoBus/S communications error occurred.
	OFF	A CompoBus/S communications error hasn't occurred.

SECTION 3
Installation and Wiring

This section provides information on installing and wiring a 3G3RV-P10ST Unit. Be sure to follow the directions and precautions in this section when installing the 3G3RV-P10ST and wiring I/O.

3-1 Installation

⚠ **WARNING** Do not touch the conductive parts such as internal PCBs or terminal blocks while power is being supplied. Doing so may result in electrical shock.

⚠ **WARNING** Turn ON the power supply of the Inverter only after mounting the front cover, terminal cover and optional items. Leave them mounted in place while power is being supplied. Not doing so may result in electrical shock, malfunction, or damage to the product.

⚠ **WARNING** Wiring, maintenance, or inspection must be performed by authorized personnel. Not doing so may result in electrical shock or fire.

⚠ **WARNING** Wiring, maintenance, or inspection must be performed after turning OFF the power supply of the Inverter, confirming that the CHARGE indicator (or status indicators) is OFF, and after waiting for the time specified on the Inverter front cover. Not doing so may result in electrical shock.

⚠ **WARNING** Do not damage, pull on, apply stress to, place heavy objects on, or pinch the cables. Doing so may result in electrical shock, operation stoppage, or burning.

⚠ **WARNING** Do not attempt to disassemble or repair the Unit. Doing either of these may result in electrical shock, injury, or damage to the product.

⚠ **Caution** Do not store, install, or operate the product in the following places. Doing so may result in electrical shock, fire or damage to the product.

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to exposure to combustibles.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.

⚠ **Caution** Do not allow foreign objects to enter inside the product. Doing so may result in fire or malfunction.

⚠ **Caution** Do not apply any strong impact. Doing so may result in damage to the product or malfunction.

⚠ **Caution** Be sure to wire correctly and securely. Not doing so may result in injury or damage to the product.

⚠ **Caution** Be sure to firmly tighten the screws on the terminal block. Not doing so may result in fire, injury, or damage to the product.

⚠ **Caution** Carefully handle the product because it uses semiconductor elements. Careless handling may result in malfunction.

⚠ **Caution** Take appropriate and sufficient countermeasures when installing systems in the following locations. Not doing so may result in equipment damage.

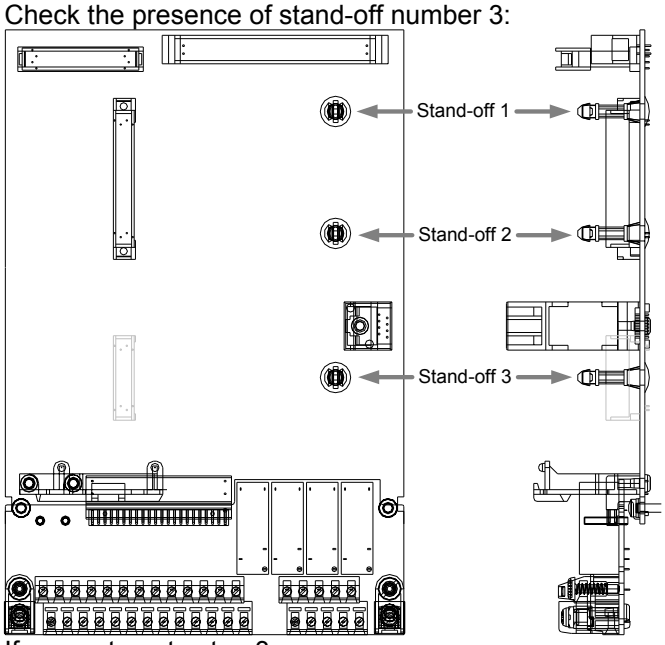
- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields and magnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

3-2 Mounting Procedure

⚠ **Caution** Before installing the PLC option board, always turn OFF the power to the Inverter and wait for the CHARGE indicator to turn OFF.

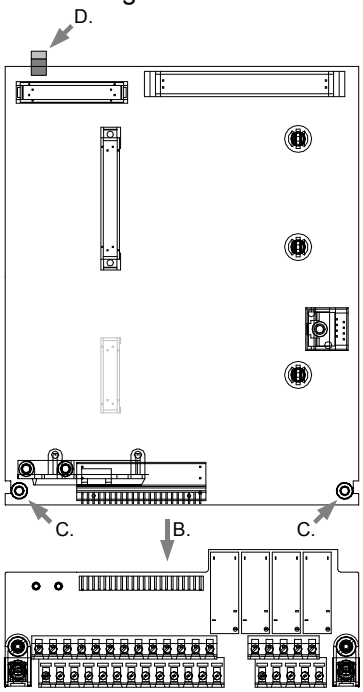
1,2,3.. **1.** Turn OFF the main circuit power supply for the Inverter, wait for at least five minutes from the time the LED indicator or the CHARGE indicator goes out, and remove the front covers of the Inverter along with the Digital Operator.

2. Check the presence of stand-off number 3:



If present, go to step 3.

A. Release the screws of terminal block and remove the terminal block by sliding it toward the bottom-side of the Inverter:



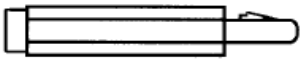
B. Release the screws of the controller-board.

C. Release locking-tab above 4CN (top-side of Inverter)

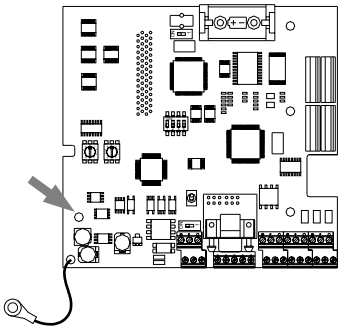
D. Take out the controller board
E. Attach the stand-off from the bottom-side of the controller board. Use the already installed stand-off-1 and -2 as a reference.

F. Put the controller-board back into the case, making sure the PCB is locked by the tab above 4CN (see D.)
G. Tighten the screws of the controller-board (see C.)
H. Slide the terminal-block back toward the controller-board (align CN8 of both boards). Tighten the screws of the terminal-block.

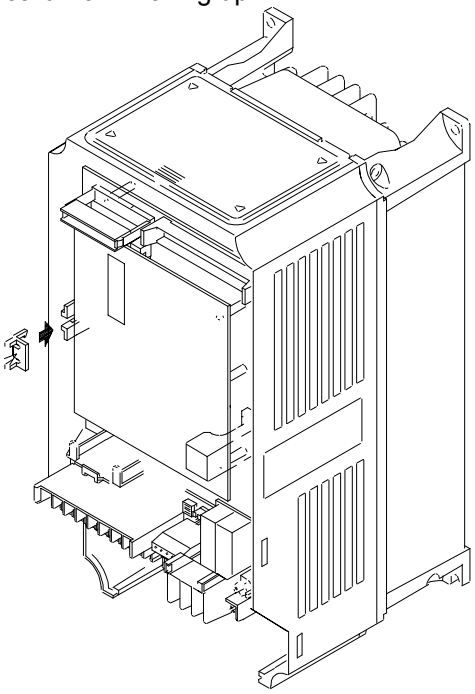
3. Attach the following stand-off to the bottom side of the PLC option board:



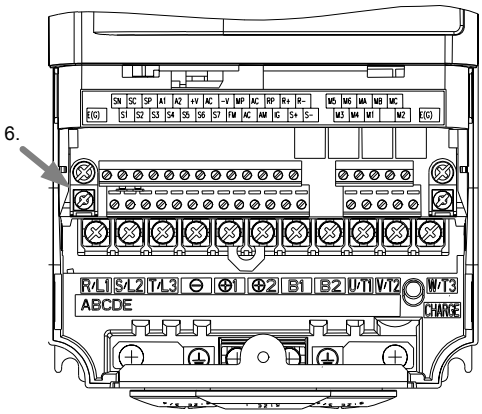
Top view PLC option board, showing the location where to fit the stand-off on the bottom side:



4. Put the PLC option board inside the inverter, making sure the board is locked by the three stand-offs.
5. Put the clip back on the left side of the Inverter which prevents the PLC option board from moving up.



6. Attach the FE-cable of the PLC option board to the FE-connection screw on the terminal-board:



3-3 Wiring

⚠ **WARNING** Wiring must be performed only after confirming that the power supply has been turned OFF. Not doing so may result in electrical shock.

⚠ **WARNING** Wiring must be performed by authorized personnel. Not doing so may result in electrical shock or fire.

⚠ **Caution** Be sure to firmly tighten the screws on the terminal block. Not doing so may result in fire, injury, or damage to the product.

3-4 Connecting I/O Devices

Wire inputs and outputs to the 3G3RV-P10ST Unit as shown in the following diagrams.

⚠ **WARNING** The PLC outputs may remain ON or OFF due to deposits on or burning of the output relay or destruction of the output transistors. External safety measures must be provided to ensure safety in the system. Not providing proper safety measures may result in serious accidents.

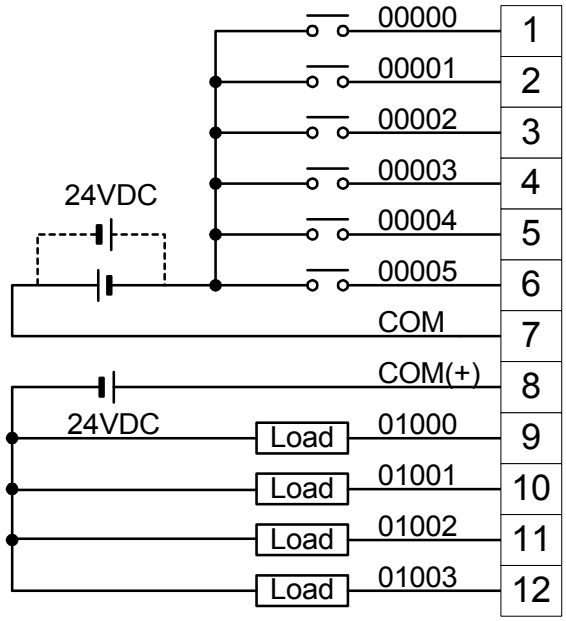
Note When equipment must conform to the EC Directives (Low-voltage Directives), use a power supply with double insulation or reinforced insulation.

⚠ **Caution** Check that wiring has been performed correctly before supplying power. Supplying power with incorrect wiring may result in damage to internal circuits.

I/O Configuration

The following diagram shows the I/O configuration.

Sourcing Transistor Outputs

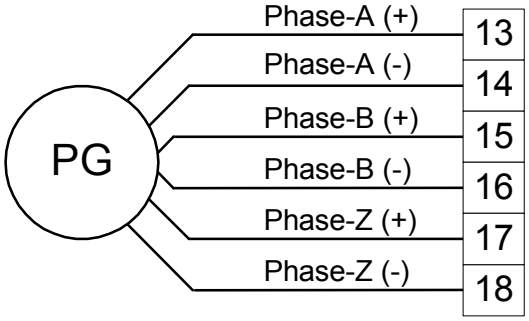


Do not exceed the output capacity or the maximum common current for transistor outputs shown in the following table.

Item	Specification
Output Capacity	200 mA at 24 VDC

Encoder interface

The following diagram shows how to connect an encoder to the Encoder interface:



3-5 Wiring Communication Cables

When wiring the RS-422/485 communication cable, make sure to use shielded cable with twisted wires.

3-6 Programming Device Connections

For a complete overview of Programming Device connections see section 3-4-9 of *W377 Operation Manual CPM2C-S*.

Note When using CX-Programmer, select CPM2*-S* as PLC Device Type.

3-7 Battery replacement

⚠ **WARNING** The backup battery may explode, catch fire, or leak if dropped, broken apart, crushed, short-circuited, recharged, heated to 100°C or higher, or burned.

Battery type

Type: Sonnenschein Lithium 1/2 AA
Model: SL-350/S

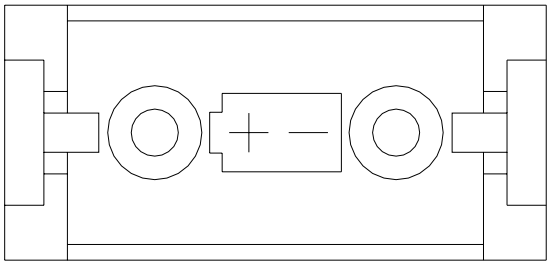
Replacing battery

If power has not been supplied to the PLC for some time, turn ON the power supply for at least 5 minutes to charge the backup capacitor before replacing the battery.

Turn OFF the power supply to the PLC before replacing the battery. To protect the contents of memory, this procedure must be completed within 5 minutes. Be sure to dispose of the old battery in accordance with local laws and regulations.
Replace the battery within five years when used under 25°C. When the battery voltage drops, the ERR/ALM indicator will flash and SR 25308 will be turned ON. In this case, replace the battery within seven days. Use the procedure below when replacing the battery.

1,2,3.. **1.** Turn OFF the main circuit power supply for the Inverter, wait for at least five minutes from the time the LED indicator or the CHARGE indicator goes out, and remove the front covers of the Inverter along with the Digital Operator.

2. Remove the battery from the battery-holder.



3. Install the new battery. Be sure the battery is positioned in the correct way, according the picture in the holder.

SECTION 4
Communication, Counter and Pulse

This section describes the communication settings and the use of the counter and pulse output functionality of the 3G3RV-P10ST.

4-1 PLC-setup Communication

4-1-1 RS-232C Port Communications Settings

The following settings are effective after transfer to the PLC.
If pin 2 of the 3G3RV-P10ST Unit's DIP switch is ON, communications through the 3G3RV-P10ST's RS-232C port are governed by the default settings (all 0) regardless of the settings in DM 6645 through DM 6649.

Word(s)	Bit(s)	Function
DM 6645	00 to 03	Port settings 0: Standard (1 start bit, 7 data bits, even parity, 2 stop bits, 9,600 bps), Host Link unit number: 0 1: Settings in DM 6646 (Any other setting will cause a non-fatal error and AR 1302 will turn ON.)
	04 to 07	CTS control setting 0: Disable CTS control; 1: Enable CTS control (Any other setting will cause a non-fatal error and AR 1302 will turn ON.)
	08 to 11	Link words for 1:1 data link 0: LR 00 to LR 15 (Any other settings are ineffective.)
	12 to 15	Communications mode 0: Host Link; 1: No-protocol; 2: 1:1 PLC Link Slave; 3: 1:1 PLC Link Master; 4: NT Link (Any other setting causes a non-fatal error and turns ON AR 1302.)
DM 6646	00 to 07	Baud rate 00: 1,200 bps; 01: 2,400 bps; 02: 4,800 bps; 03: 9,600 bps; 04: 19,200 bps
	08 to 15	Frame format 00: 1 bit, 7 bits, 1 bit, Even 01: 1 bit, 7 bits, 1 bit, Odd 02: 1 bit, 7 bits, 1 bit, None 03: 1 bit, 7 bits, 2 bits, Even 04: 1 bit, 7 bits, 2 bits, Odd 05: 1 bit, 7 bits, 2 bits, None 06: 1 bit, 8 bits, 1 bit, Even 07: 1 bit, 8 bits, 1 bit, Odd 08: 1 bit, 8 bits, 1 bit, None 09: 1 bit, 8 bits, 2 bits, Even 10: 1 bit, 8 bits, 2 bits, Odd 11: 1 bit, 8 bits, 2 bits, None (Any other setting specifies standard settings (1 start bit, 7 data bits; even parity, 2 stop bits, 9,600 bps), causes a non-fatal error, and turns ON AR 1302.)
DM 6647	00 to 15	Transmission delay (0000 to 9999 BCD sets a delay of 0 to 99,990 ms.) (Any other setting specifies a delay of 0 ms, causes a non-fatal error, and turns ON AR 1302.)
DM 6648	00 to 07	Node number (Host Link) 00 to 31 (BCD) (Any other setting specifies a node number of 00, causes a non-fatal error, and turns ON AR 1302.)
	08 to 11	Start code selection for no-protocol communications 0: Disables start code; 1: Enables start code in DM 6649 (Any other setting disables the start code, causes a non-fatal error, and turns ON AR 1302.)
	12 to 15	End code selection for no-protocol communications 0: Disables end code; 1: Enables end code in DM 6649; 2: Sets end code of CR, LF. (Any other setting disables the end code, causes a non-fatal error, and turns ON AR 1302.)

Word(s)	Bit(s)	Function
DM 6649	00 to 07	Start code (00 to FF) (This setting is valid only when bits 8 to 11 of DM 6648 are set to 1.)
	08 to 15	When bits 12 to 15 of DM 6648 set to 0: Sets the number of bytes to receive. (00: 256 bytes; 01 to FF: 1 to 255 bytes) When bits 12 to 15 of DM 6648 set to 1: Sets the end code. (00 to FF)

4-1-2 Peripheral RS-422/485 Port Communications Settings

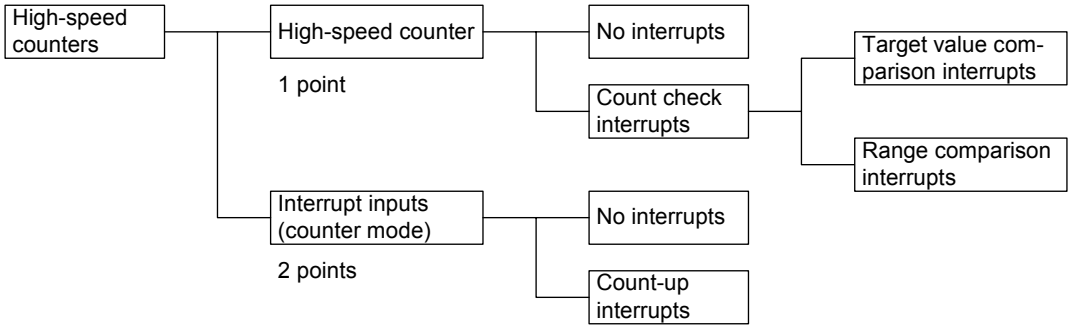
The following settings are effective after transfer to the PLC.
If the 3G3RV-P10ST Unit's Communications Switch is ON, communications through the peripheral port are governed by the default settings (all 0) regardless of the settings in DM 6650 through DM 6654.
The 3G3RV-P10ST's Communications Switch setting has no effect on communications with a Programming Console connected to the peripheral port or Support Software set for peripheral bus communications. The 3G3RV-P10ST Unit will auto-detect either Programming Device and automatically establish communications.

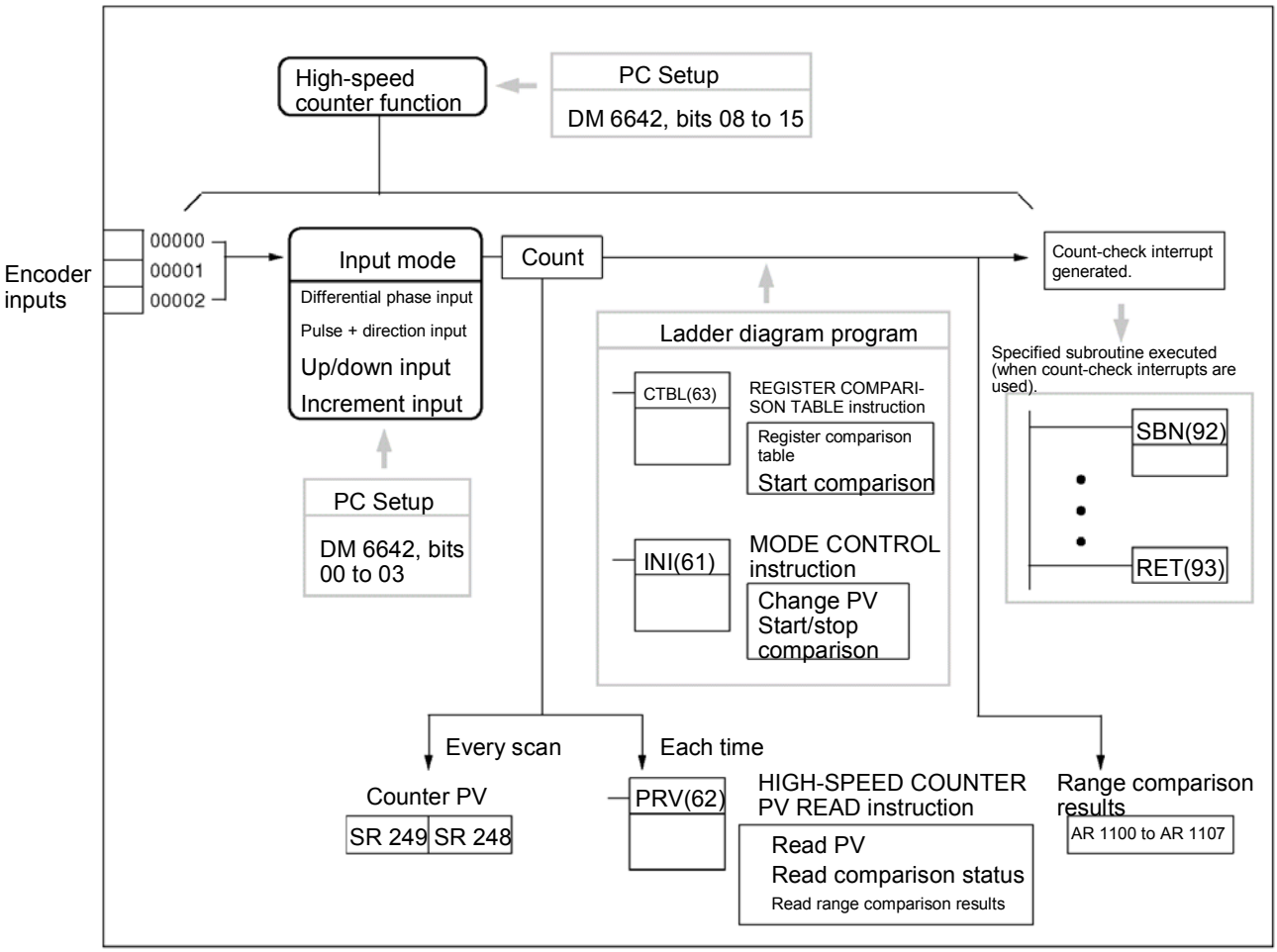
Word(s)	Bit(s)	Function
DM 6650	00 to 03	Port settings 0: Standard (1 start bit, 7 data bits, even parity, 2 stop bits, 9,600 bps), Host Link unit number: 0 1: Settings in DM 6651 (Any other setting will cause a non-fatal error and AR 1302 will turn ON.)
	04 to 11	Not used.
	12 to 15	Communications mode 0: Host Link or peripheral bus; 1: No-protocol (Any other setting causes a non-fatal error and turns ON AR 1302.)
DM 6651	00 to 07	Baud rate 00: 1,200 bps; 01: 2,400 bps; 02: 4,800 bps; 03: 9,600 bps; 04: 19,200 bps
	08 to 15	Frame format 00: 1 bit, 7 bits, 1 bit, Even 01: 1 bit, 7 bits, 1 bit, Odd 02: 1 bit, 7 bits, 1 bit, None 03: 1 bit, 7 bits, 2 bits, Even 04: 1 bit, 7 bits, 2 bits, Odd 05: 1 bit, 7 bits, 2 bits, None 06: 1 bit, 8 bits, 1 bit, Even 07: 1 bit, 8 bits, 1 bit, Odd 08: 1 bit, 8 bits, 1 bit, None 09: 1 bit, 8 bits, 2 bits, Even 10: 1 bit, 8 bits, 2 bits, Odd 11: 1 bit, 8 bits, 2 bits, None (Any other setting specifies standard settings (1 start bit, 7 data bits; even parity, 2 stop bits, 9,600 bps), causes a non-fatal error, and turns ON AR 1302.)
DM 6652	00 to 15	Transmission delay (0000 to 9999 BCD sets a delay of 0 to 99,990 ms.) (Any other setting specifies a delay of 0 ms, causes a non-fatal error, and turns ON AR 1302.)

Word(s)	Bit(s)	Function
DM 6653	00 to 07	Node number (Host Link) 00 to 31 (BCD) (Any other setting specifies a node number of 00, causes a non-fatal error, and turns ON AR 1302.)
	08 to 11	Start code selection for no-protocol communications 0: Disables start code; 1: Enables start code in DM 6654 (Any other setting disables the start code, causes a non-fatal error, and turns ON AR 1302.)
	12 to 15	End code selection for no-protocol communications 0: Disables end code; 1: Enables end code in DM 6649; 2: Sets end code of CR, LF. (Any other setting disables the end code, causes a non-fatal error, and turns ON AR 1302.)
DM 6654	00 to 07	Start code (00 to FF) (This setting is valid only when bits 8 to 11 of DM 6653 are set to 1.)
	08 to 15	When bits 12 to 15 of DM 6653 set to 0: Sets the number of bytes to receive. (00: 256 bytes; 01 to FF: 1 to 255 bytes) When bits 12 to 15 of DM 6653 set to 1: Sets the end code. (00 to FF)

4-2 High-speed Counters

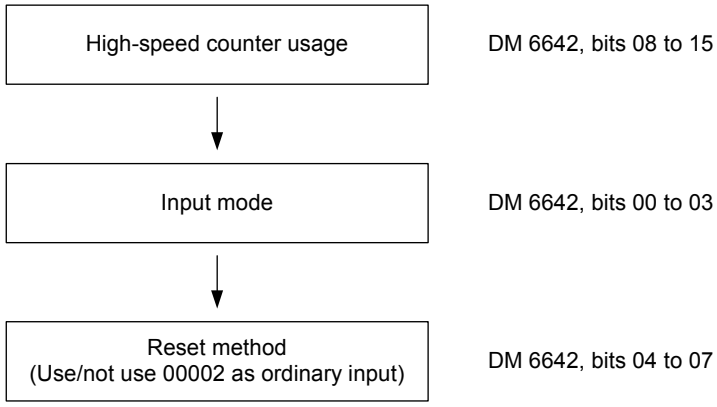
3G3RV-P10ST Units have four points for high-speed counters: One point for a high-speed counter with a maximum response frequency of 20 kHz, and three points for interrupt inputs (counter mode).
For more details please refer to Programming Manual W353





PLC Setup

Set the PLC Setup areas related to the high-speed counter as follows:



Word	Bits	Function	Setting
DM 6642	00 to 03	High-speed counter input mode setting 0: Differential phase input 5 kHz 1: Pulse + direction input 20 kHz 2: Up/down input 20 kHz 4: Increment 20 kHz	0, 1, 2, or 4
	04 to 07	High-speed counter reset method setting 0: Phase-Z signal + software reset 1: Software reset	0 or 1
	08 to 15	High-speed counter usage setting 00: Do not use. 01: Use as high-speed counter 02: Use as pulse synchronization control (10 Hz to 500 Hz) 03: Use as pulse synchronization control (20 Hz to 1 kHz) 04: Use as pulse synchronization control (300 Hz to 20 kHz)	01

The new settings for the System Setup go into effect when operation begins (when PROGRAM mode is changed to MONITOR or RUN mode), or when the 3G3RV-P10ST's power is turned ON.

Ladder Diagram Programming

The following table shows the instructions related to high-speed counter control.

Instruction	Control	Operation
(@)CTBL(63)	Register target value comparison table	Registers target value comparison table.
	Register range comparison table	Registers range comparison table.
	Register target value comparison table and start comparison	Registers target value comparison table and starts comparison.
	Register range comparison table and start comparison	Registers range comparison table and starts comparison.
(@)INI(61)	Start comparison	Starts comparison with registered comparison table.
	Stop comparison	Stops comparison.
	Change PV	Changes the high-speed counter PV.
(@)PRV(62)	Read PV	Reads the high-speed counter PV.
	Read status	Reads the high-speed counter status.
	Read range comparison result	Reads range comparison result.
(@)INT(89)	Mask all interrupts	Prohibits all interrupts, including interrupt inputs, interval timer interrupts, high-speed counters, etc.
	Unmask all interrupts	Permits all interrupts, including interrupt inputs, interval timer interrupts, high-speed counters, etc.

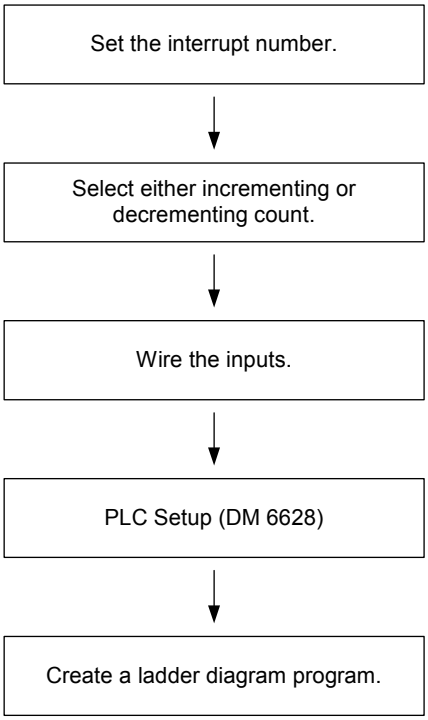
The following table shows the data areas related to high-speed counter control.

Word	Bits	Name	Contents
248 249	00 to 15 00 to 15	High-speed counter PV	Reads high-speed counter PV.
252	00	High-speed counter reset	When this bit turns ON, a software reset is triggered for the high-speed counter.
AR11	00 to 07	High-speed counter range comparison results	ON: Condition satisfied OFF: Condition not satisfied
	08	High-speed counter comparison	ON: Comparison in progress OFF: Comparison stopped
	09	High-speed counter PV overflow/underflow	ON: Overflow/underflow OFF: Normal

4-3 Input Interrupts In Counter Mode

The four built-in interrupt inputs in the 3G3RV-P10ST Unit can be used in counter mode as inputs of up to 2 kHz. These inputs can be used as either incrementing counters or decrementing counters, triggering an interrupt (i.e., executing an interrupt subroutine) when the count matches the set value. For more details please refer to Programming Manual W353

Procedure for Using Interrupt Inputs in Counter Mode

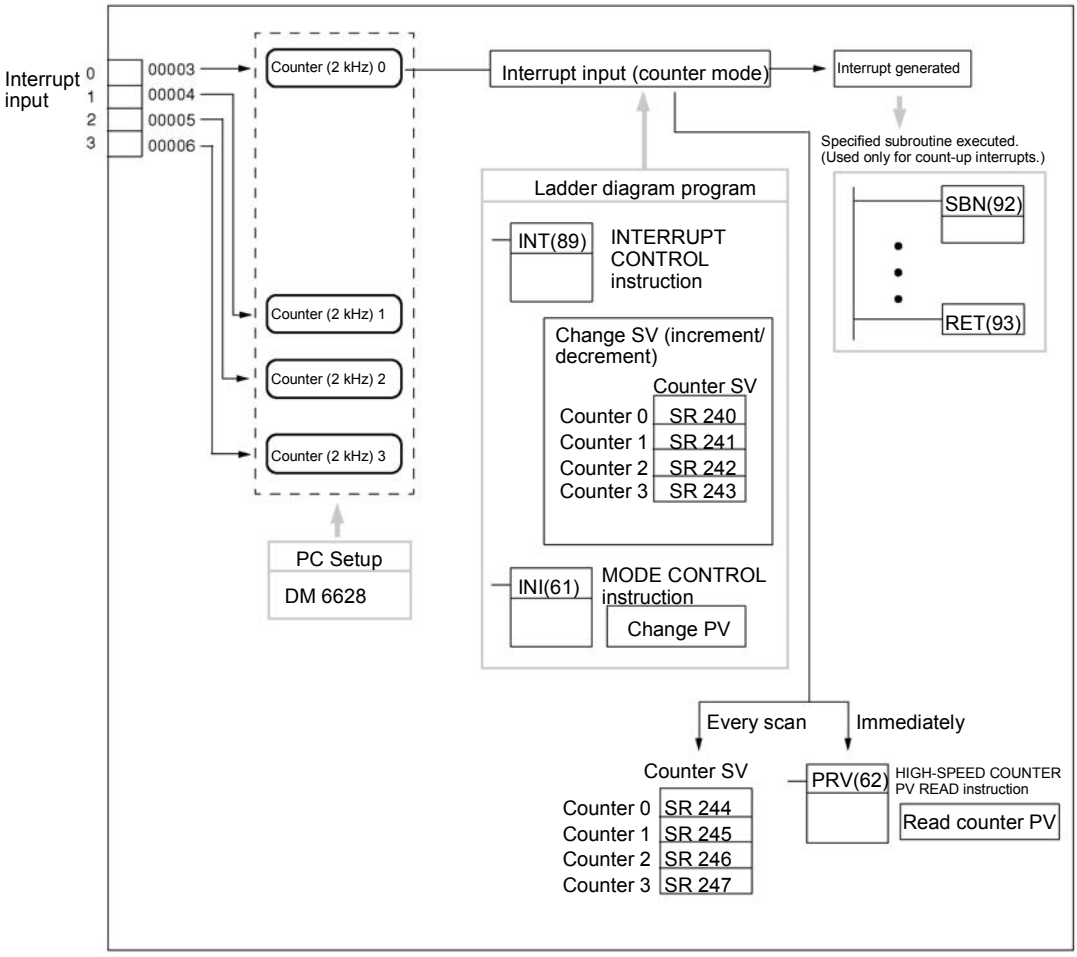


Input numbers: 00003 or 00004

1. Use as interrupt input (interrupt input mode or counter mode)

INI(61): Change counter PV
INT(89): Refresh SV*
(PRV(62): Read counter PV
SBN(92) and RET(93): For creating interrupt subroutines.*

*Used only for count-up interrupts.



Note Input point 00005 cannot be used as interrupt input.
Input point 00006 does not exist.

PLC Setup

The following table shows the settings in the PLC Setup area related to interrupt input usage.

Word	Bits	Function		Setting
DM 6628	00 to 03	Interrupt setting for input 00003	0: Normal input 1: Interrupt input (interrupt input mode or counter mode) 2: Quick-response input	1
	04 to 07	Interrupt setting for input 00004		
	08 to 15	Not used.		0

The setting will go into effect when the mode is changed (from PROGRAM to MONITOR/RUN) or when the power supply is turned ON to the 3G3RV-P10ST.

Ladder Diagram Programming

The following table shows the instruction operations related to interrupt input (counter mode) control.

Instruction	Control	Operation
(@)INT(89)	Refresh incrementing counter SV	Refreshes the counter's SV and starts the incrementing count.
	Refresh decrementing counter SV	Refreshes the counter's SV and starts the decrementing count.
	Mask all interrupts	Prohibits all interrupts, including interrupt inputs, interval timer interrupts, high-speed counters, etc.
	Unmask all interrupts	Permits all interrupts, including interrupt inputs, interval timer interrupts, high-speed counters, etc.
(@)INI(61)	Change PV	Changes the counter's PV.
(@)PRV(62)	Read PV	Reads the counter's PV.

The functions related to input interrupts (counter mode) are executed according to the data areas shown in the following table.

Word	Bits	Name	Contents
240	00 to 15	SV area for input interrupt (counter mode) 0	Stores the counter's set value(SV) .
241	00 to 15	SV area for input interrupt (counter mode) 1	
242	00 to 15	SV area for input interrupt (counter mode) 2	
243	00 to 15	SV area for input interrupt (counter mode) 3	
244	00 to 15	PV area for input interrupt (counter mode) 0	Stores the counter's present value (PV).
245	00 to 15	PV area for input interrupt (counter mode) 1	
246	00 to 15	PV area for input interrupt (counter mode) 2	
247	00 to 15	PV area for input interrupt (counter mode) 3	

Refresh Incrementing Counter SV / Refresh Decrementing Counter SV

These functions store the counter's set values in data areas and refresh them by means of INT(89). In this way, they start the count operation for interrupt inputs (counter mode) and they permit interrupts.

Storing Set Values in Data Areas

The counter's set values are stored in words 240, 241, 242, and 243.

SR 240	SV for interrupt input (count mode) 0: 0000 to FFFF
SR 241	SV for interrupt input (count mode) 1: 0000 to FFFF
SR 242	SV for interrupt input (count mode) 2: 0000 to FFFF
SR 243	SV for interrupt input (count mode) 3: 0000 to FFFF

4-4 Pulse Output Functions

The 3G3RV-P10ST has two pulse outputs. By means of a selection in the PLC Setup, these outputs can be used as two single-phase outputs without acceleration and deceleration, two variable duty ratio pulse outputs, or pulse outputs with trapezoidal acceleration/deceleration (one pulse + direction output and one up/ down pulse output). The pulse output PV coordinate system can also be specified in the PLC Setup as either relative or absolute.
There are two pulse output modes: Independent mode, in which outputs are stopped at a preset amount of pulses, and continuous mode, in which outputs are stopped by an instruction.
For more details please refer to Programming Manual W353

Item		Single-phase pulse outputs without accel/decel	Variable duty ratio pulse outputs	Single-phase pulse outputs with trapezoidal acceleration/deceleration			
				Pulse + direction outputs		Up/down pulse outputs	
Execution instructions		PULS(65) and SPED(64)	PWM(—)	PULS(65) and ACC(—)			
Output number	01000	Pulse output 0 (See note 1.)	Pulse output 0 (See note 1.)	Pulse output 0	Pulse output	Pulse output 0	CW pulse output
	01001	Pulse output 1 (See note 1.)	Pulse output 1 (See note 1.)		Direction output		CCW pulse output
Output frequency range		10 Hz to 10 kHz	0.1 to 999.9 Hz	10 Hz to 10 kHz		10 Hz to 10 kHz	
	Pitch	10 Hz	0.1 Hz	10 Hz		10 Hz	
Up/down frequency pitch		---	---	10 Hz (See note 2.)		10 Hz (See note 2.)	
Start speed pitch		---	---	10 Hz		10 Hz	
Output mode		Continuous, Independent	Continuous	Continuous, Independent		Continuous, Independent	
	Number of pulses	1 to 16777215	---	±1 to 16777215		±1 to 16777215	
Duty ratio (See note 3.)		50%	0 to 100%	50%		50%	
Control method	Movement specification	Yes	No	Yes		Yes	
	Accel/decel specification	No	No	Yes		Yes	
	Start speed specification	No	No	Yes		Yes	
	Duty specification	No	Yes	No		No	

Note 1. With single-phase pulse outputs, pulse outputs 0 and 1 can each be output independently.

2. Pulse outputs can be accelerated or decelerated in units of 10 Hz every 10 ms.

3. Actual pulses are affected by the transistor output's ON response time (20 μs max.) and OFF response time (40 μs max.).

4-4-1 Using Single-phase Pulse Fixed Duty Ratio

Select the pulse output number.

Pulse output number 0 or 1

↓

Wire the outputs.

Output numbers: 01000 and 01001

↓

PLC Setup (DM 6629)

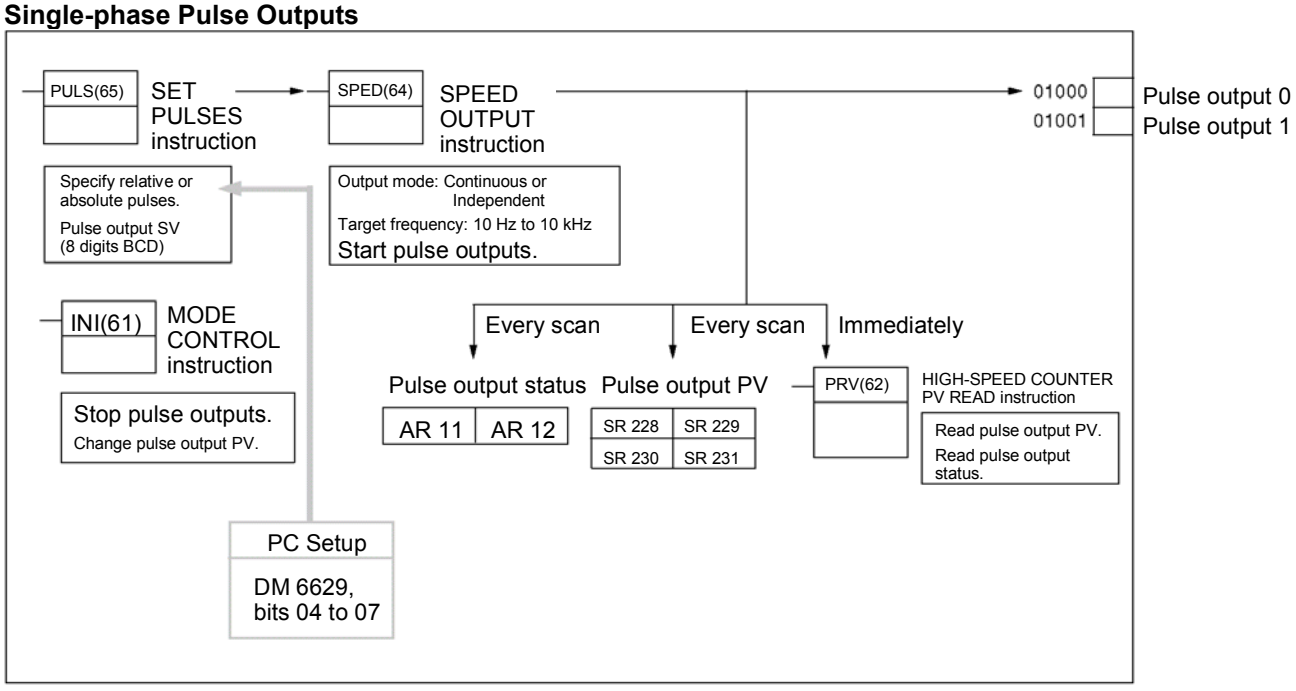
PV coordinatesystem for pulse output 0 and 1

↓

Create a ladder diagram program.

PULS(65): For setting the number of pulses.
SPED(64): For pulse output control without acceleration and deceleration.
INI(61): For stopping pulse outputs and changing the pulse output PV.
PRV(62): For reading the pulse output PV and status.

Single-phase Pulse Outputs



PLC Setup

Make the following settings in the PLC Setup.

Word	Bits	Function		Setting
DM 6629	00 to 03	Pulse 0 PV coordinate system	0: Relative coordinate system 1: Absolute coordinate system	Either 0 or 1
	04 to 07	Pulse 1 PV coordinate system		
DM 6642	08 to 15	High-speed counter setting	00: Do not use. 01: Use as high-speed counter 02: Use as synchronized pulse control (10 to 500 Hz). 03: Use as synchronized pulse control (20 Hz to 1 kHz). 04: Use as synchronized pulse control (300 Hz to 20 kHz).	Either 00 or 01

If absolute pulses are specified with PULS(65), be sure to set the absolute coordinate system (1).

Synchronized pulse control cannot be used simultaneously.

The settings will go into effect when the mode is changed (from PROGRAM to MONITOR/RUN) or when the power supply is turned ON to the PLC.

Ladder Diagram Programming

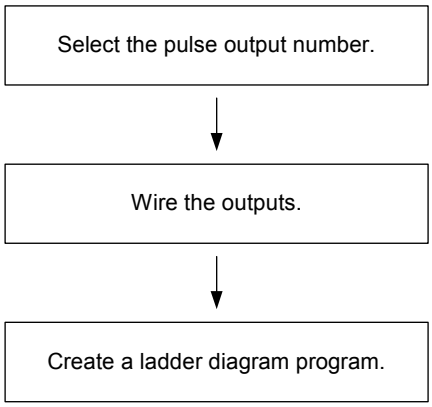
The following table shows the instruction operations related to pulse outputs without acceleration and deceleration (fixed duty ratio).

Instruction	Control	Operation
(@)PULS(65)	Set number of pulses	Sets the number of pulses to be output in independent mode.
(@)SPED(64)	Set frequency and start pulse outputs	Sets the frequency for outputs in the independent mode or continuous mode, and starts the pulse outputs.
	Change frequency	Changes the frequency for outputs in the independent mode or continuous mode.
	Stop pulse outputs	Stops the pulse outputs (by changing the speed to a frequency of 0 Hz).
(@)INI(61)	Stop pulse outputs	Stops the pulse outputs.
	Change pulse output PV	Changes the pulse output PV.
(@)PRV(62)	Read pulse output PV	Reads the pulse output PV.
	Read pulse output status	Reads the pulse output status.

The following table shows the words and bits related to pulse outputs without acceleration and deceleration (fixed duty ratio).

Word	Bits	Name	Contents
228	00 to 15	Pulse output PV 0, rightmost 4 digits	Cannot be used as work bits even when not used as pulse outputs.
229	00 to 15	Pulse output PV 0, leftmost 4 digits	
230	00 to 15	Pulse output PV 1, rightmost 4 digits	
231	00 to 15	Pulse output PV 1, leftmost 4 digits	
252	04	Pulse output 0 PV reset	Clears PV 0 when ON.
	05	Pulse output 1 PV reset	Clears PV 1 when ON.
AR 11	12	Pulse output 0 PV over-flow/underflow	ON: Occurred OFF: Normal
	13	Number of pulses set for pulse output 0	ON: Set (by PULS(65)) OFF: Not set
	14	Pulse output completed for pulse output 0	ON: Completed (by SPED(64)) OFF: Not completed
	15	Pulse output in progress for pulse output 0	ON: In progress (by SPED(64)) OFF: Stopped
AR 12	12	Pulse output 1 PV over-flow/underflow	ON: Occurred OFF: Normal
	13	Number of pulses set for pulse output 1	ON: Set (by PULS(65)) OFF: Not set
	14	Pulse output completed for pulse output 1	ON: Completed (by SPED(64)) OFF: Not completed
	15	Pulse output in progress for pulse output 1	ON: In progress (by SPED(64)) OFF: Stopped

4-4-2 Using Pulse Outputs With Variable Duty Ratio

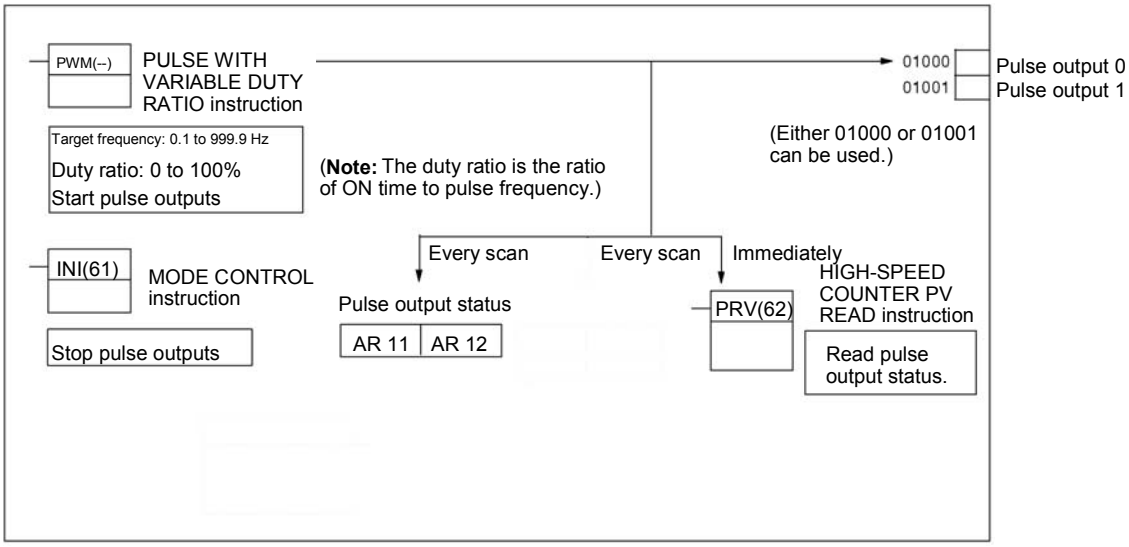


Pulse output number 0 or 1

Output numbers: 01000 and 01001

PWM(---): For setting the frequency and duty ratio.
INI(61): For stopping outputs.
PRV(62): For reading the pulse output status.

Pulse Outputs With Variable Duty Ratio



PLC Setup

Make the following settings in the PLC Setup.

Word	Bits	Function		Setting
DM 6642	08 to 15	High-speed counter setting	00: Do not use. 01: Use as high-speed counter 02: Use as synchronized pulse control (10 to 500 Hz). 03: Use as synchronized pulse control (20 Hz to 1 kHz). 04: Use as synchronized pulse control (300 Hz to 20 kHz).	Either 00 or 01

Synchronized pulse control cannot be used simultaneously.
The settings will go into effect when the mode is changed (from PROGRAM to MONITOR/RUN) or when the power supply is turned ON to the PLC.

Ladder Diagram Programming

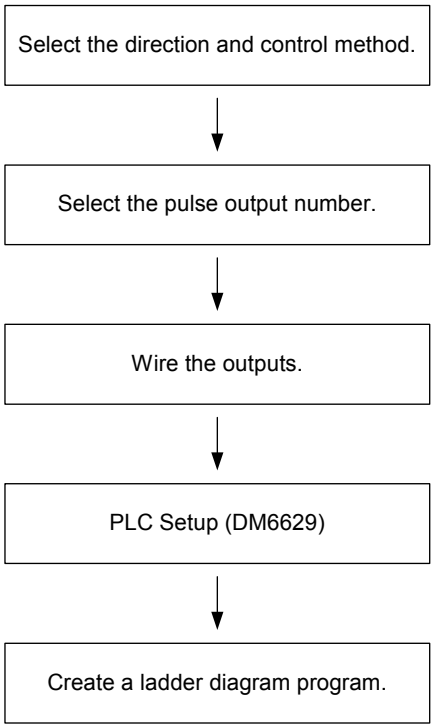
The following table shows the instruction operations related to pulse outputs with variable duty ratio.

Instruction	Control	Operation
(@)PWM(—)	Pulse output with variable duty ratio	Sets the frequency and duty ratio and starts the pulse outputs.
	Change duty ratio	Changes the duty ratio during pulse while pulse outputs with variable duty ratio are already in progress.
(@)INI(61)	Stop pulse outputs	Stops the pulse outputs.
(@)PRV(62)	Read pulse output status	Reads the pulse output status (during pulse outputs).

The following table shows the words and bits related to pulse outputs with variable duty ratio.

Word	Bit	Name	Contents
AR 11	15	Pulse output in progress for pulse output 0	ON: In progress (by SPED(64), ACC(—), or PWM(—)) OFF: Stopped
AR 12	15	Pulse output in progress for pulse output 1	ON: In progress (by SPED(64), ACC(—), or PWM(—)) OFF: Stopped

4-4-3 Using Pulse Outputs With Trapezoidal Acceleration/Deceleration



Pulse + direction or up/down output

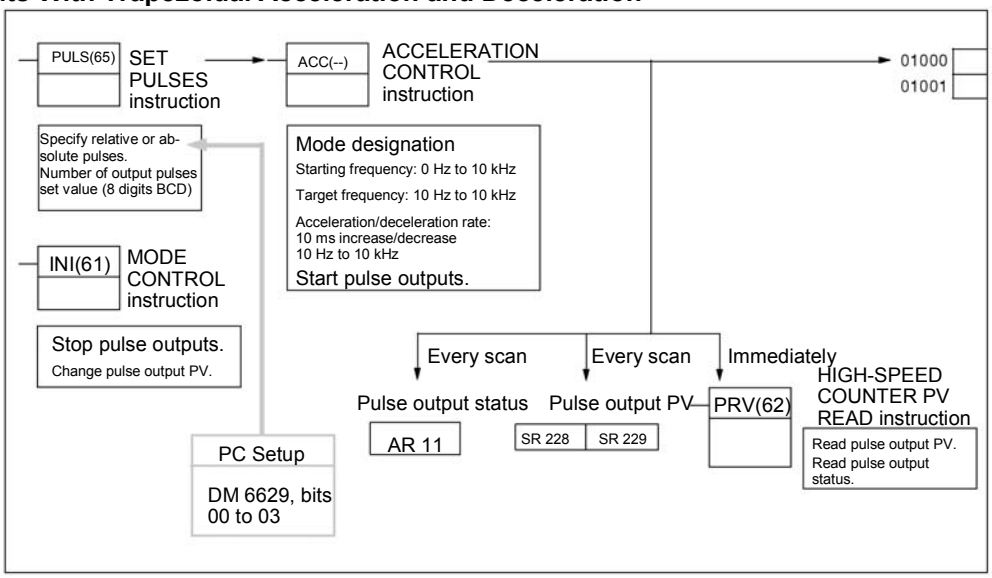
Pulse output number 0

Output numbers: 01000 and 01001

PV coordinate system for pulse output number 0

PULS(65): For setting the number of output pulses.
ACC(---): For controlling pulse outputs with trapezoidal acceleration and deceleration
INI(61): For stopping pulse outputs and changing the pulse output PV.
PRV(62): For reading the pulse output PV and status.

Pulse Outputs With Trapezoidal Acceleration and Deceleration



PLC Setup

Make the following settings in the PLC Setup.

Word	Bits	Function		Setting
DM 6629	00 to 03	Pulse 0 PV coordinate system	0: Relative coordinate system 1: Absolute coordinate system	Either 0 or 1
DM 6642	08 to 15	High-speed counter setting	00: Do not use. 01: Use as high-speed counter 02: Use as synchronized pulse control (10 to 500 Hz). 03: Use as synchronized pulse control (20 Hz to 1 kHz). 04: Use as synchronized pulse control (300 Hz to 20 kHz).	Either 00 or 01

If absolute pulses are specified with PULS(65), be sure to set the absolute coordinate system (1).
Synchronized pulse control cannot be used simultaneously.
The settings will go into effect when the mode is changed (from PROGRAM to MONITOR/RUN) or when the power supply is turned ON to the PLC.

Ladder Diagram Programming

The following table shows the instruction operations related to pulse outputs with trapezoidal acceleration and deceleration (fixed duty ratio).

Instruction	Control	Operation
(@)PULS(65)	Set number of pulses	Sets the number of pulses to be output in independent mode.
(@)ACC(—)	Set frequency and start pulse outputs	Sets the target frequency, starting frequency, and acceleration/deceleration rate for outputs in independent mode or continuous mode, and starts the pulse outputs.
	Change frequency	Changes the frequency during pulse output in continuous mode by accelerating or decelerating according to the specified acceleration/deceleration rate.
	Stop pulse outputs	Decelerates pulse outputs to a stop according to the specified acceleration/deceleration rate.
(@)INI(61)	Stop (decelerate stop) pulse outputs	Stops the pulse outputs.
	Change pulse output PV	Changes the pulse output PV.
(@)PRV(62)	Read pulse output PV	Reads the pulse output PV.
	Read pulse output status	Reads the pulse output status.

The following table shows the words and bits related to pulse outputs with trapezoidal acceleration and deceleration (fixed duty ratio).

Word	Bits	Name	Contents
228	00 to 15	Pulse output PV 0, rightmost 4 digits	Cannot be used as work bits even when not used as pulse outputs.
229	00 to 15	Pulse output PV 0, leftmost 4 digits	
230	00 to 15	Pulse output PV 1, rightmost 4 digits	
231	00 to 15	Pulse output PV 1, leftmost 4 digits	
252	04	Pulse output 0 PV reset	Clears PV 0 when ON.
	05	Pulse output 1 PV reset	Clears PV 1 when ON.
AR 11	11	Pulse output status for pulse output 0	ON: Accelerating or decelerating OFF: Constant speed
	12	Pulse output 0 PV overflow/underflow	ON: Occurred OFF: Normal
	13	Number of pulses set for pulse output 0	ON: Set OFF: Not set
	14	Pulse output completed for pulse output 0	ON: Completed OFF: Not completed
	15	Pulse output in progress for pulse output 0	ON: In progress (by SPED(64), ACC(—), or PWM(—)) OFF: Stopped

SECTION 5
Inverter Interface

This section describes the interface to the Inverter.

5-1 Inverter interface

The communication between the PLC and the Inverter is performed by:

- Inverter functionality mapped in IR (section 5-2)
- Inverter functionality mapped in DM (section 5-3)
- Through the Transfer command (section 5-4)

5-2 I/O Allocation IR

The contents of the IR area is refreshed and updated each PLC-cycle. Because the PLC-cycle is not synchronised with the Inverter-cycle and both are not the same in duration, it can take several PLC- or Inverter-cycles to update or refresh that data.

Word(s)	Bit(s)	Function	MEMOBUS Register	Read/ write
IR 200	00	Run (ON: During run)	0010.0	Read-only
	01	Zero speed (ON: Zero speed)	0010.1	
	02	Reverse operation (ON: During reverse operation)	0010.2	
	03	Error-reset signal (IR 207.09) (ON: Reset signal active)	0010.3	
	04	Speed agree (ON: During speed agree)	0010.4	
	05	Inverter ready (ON: Inverter ready)	0010.5	
	06	Alarm (minor fault) (ON: Alarm occurring)	0010.6	
	07	Fault (ON: Fault occurring)	0010.7	
	08	OPE error (ON: OPE error occurring)	0011.0	
	09	Momentary power interruption recovery (ON: Power restored)	---	
	10	RUN command mode (ON: Controlled by Inverter interface; OFF: Other)	---	
	11	Multi-function output 1 (M1-M2) status (ON: Closed)	0020.5	
	12	Multi-function output 2 (P1 or M3-M4) status (ON: Closed)	0020.6	
	13	Multi-function output 3 (P2 or M5-M6) status (ON: Closed)	0020.7	
	14	Motor selection (ON: Motor 2 selected)	---	
	15	Zero servo completion (ON: Zero servo completion)	---	
IR 201	00	Fuse blown (FU)	0014.0	Read-only
	01	Main circuit undervoltage (UV1)	0014.1	
	02	Control power supply error (UV2)	0014.2	
	03	Inrush prevention circuit error (UV3)	0014.3	
	04	*Reserved*	---	
	05	Ground fault (GF)	0014.5	
	06	Over current (OC)	0014.6	
	07	Overvoltage (OV)	0014.7	
	08	Inverter heatsink overheat pre-alarm (OH)	0014.8	
	09	Inverter heatsink overheat (OH1)	0014.9	
	10	Motor overload (OL1)	0014.A	
	11	Inverter overload (OL2)	0014.B	
	12	Overtorque detection 1 (OL3)	0014.C	
	13	Overtorque detection 2 (OL4)	0014.D	
	14	Internal braking transistor fault (RR)	0014.E	
	15	Inverter mounted braking resistor overheat (RH)	0014.F	

Word(s)	Bit(s)	Function	MEMOBUS Register	Read/ write
IR 202	00	External fault 3 (EF3)	0015.0	Read-only
	01	External fault 4 (EF4)	0015.1	
	02	External fault 5 (EF5)	0015.2	
	03	External fault 6 (EF6)	0015.3	
	04	External fault 7 (EF7)	0015.4	
	05	*Reserved*	---	
	06	*Reserved*	---	
	07	Overspeed detected (OS)	0015.7	
	08	Speed deviation detected (DEV)	0015.8	
	09	PG disconnected (PGO)	0015.9	
	10	Input phase loss (PF)	0015.A	
	11	Output open phase (LF)	0015.B	
	12	Motor overheat pre-alarm (PTC analog input) (OH3)	0015.C	
	13	Digital operator disconnected (OPR)	0015.D	
	14	EEPROM Write fault (ERR)	0015.E	
	15	Motor overheat (PTC analog input) (OH4)	0015.F	
IR 203	00 to 03	*Reserved*	---	Read-only
	04	Control fault (CF)	0016.4	
	05	Zero Servo fault (SVE)	---	
	06	External fault from optional input card (EF0)	0016.6	
	07	PID feedback lost (FbL)	0016.7	
	08	Undertorque detection 1 (UL3)	0016.8	
	09	Undertorque detection 2 (UL4)	0016.9	
	10	High Slip Braking overload (OL7)	0016.A	
	11 to 14	*Reserved*	---	
	15	Control board error (CPF)	0021.8	
IR 204	00	Input terminal S1 (ON: Closed)	002B.0	Read-only
	01	Input terminal S2 (ON: Closed)	002B.1	
	02	Multi-function input terminal S3 (ON: Closed)	002B.2	
	03	Multi-function input terminal S4 (ON: Closed)	002B.3	
	04	Multi-function input terminal S5 (ON: Closed)	002B.4	
	05	Multi-function input terminal S6 (ON: Closed)	002B.5	
	06	Multi-function input terminal S7 (ON: Closed)	002B.6	
	07 to 15	*Reserved*	---	
IR 205	00	NetRef status (OFF: Inverter reference enabled; ON: PLC enabled) (Note 1.)	---	Read-only
	01	NetCtrl status(OFF: Inverter control enabled; ON: PLC enabled) (Note 2.)	---	
	02 to 07	*Reserved*	---	
	08	Stall prevention operating flag	---	
	09 to 15	*Reserved*	---	
IR 206	00	Inverter Ready (error detected by mutual diagnosis) (ON: Normal; OFF: Error)	---	Read-only
	01	Transfer Completion (ON: Transfer completed)	---	
	02	Transfer Error (ON: Error; OFF: Normal)	---	
	03	Transfer Busy (ON: Busy; OFF: Ready for transfer)	---	
	04 to 15	*Reserved*	---	

Word(s)	Bit(s)	Function	MEMOBUS Register	Read/ write
IR 207	00	Forward/Stop (ON: Forward operation)	---	Read/ write
	01	Reverse/Stop (ON: Reverse operation)	---	
	02	Multi-function input command 3 (terminal S3)	0001.6	
	03	Multi-function input command 4 (terminal S4)	0001.7	
	04	Multi-function input command 5 (terminal S5)	0001.8	
	05	Multi-function input command 6 (terminal S6)	0001.9	
	06	Multi-function input command 7 (terminal S7)	0001.A	
	07	Multi-function input command 8 (terminal S8)	0001.B	
	08	External error (ON: Fault EFO)	0001.2	
	09	Error reset command (ON: Reset command)	0001.3	
	10	Multi-function input command 9 (terminal S9)	0001.C	
	11	Multi-function input command 10 (terminal S10)	0001.D	
	12	Multi-function input command 11 (terminal S11)	0001.E	
	13	Multi-function input command 12 (terminal S12)	0001.F	
	14	Error log clear	---	
	15	Baseblock active (ON: Baseblock active)	0019.7	
IR 208	00	Multi-function output 1 (M1-M2) (ON: Output ON)	0009.0	Read/ write
	01	Multi-function output 2 (P1 or M3-M4) (ON: Output ON)	0009.1	
	02	Multi-function output 3 (P2 or M5-M6) (ON: Output ON)	0009.2	
	03	Multi-function PHC output 3 (P3-C3) (ON: Output ON)	0009.3	
	04	Multi-function PHC output 4 (P4-C4) (ON: Output ON)	0009.4	
	05	*Reserved*	---	
	06	Enables/disables error contact (MA/MB-MC) setting using bit 7 (ON: use bit 7)	0009.6	
	07	Error contact (MA/MB-MC) (ON: Output ON)	0009.7	
	08 to 15	*Reserved*	---	
IR 209	00	/NetRef 1 (ON: Inverter reference enabled; OFF: PLC enabled) (Note 3.)	---	Read/ write
	01	/NetCtrl 1 (ON: Inverter control enabled; OFF: PLC enabled) (Note 4.)	---	
	02 to 15	*Reserved*	---	
IR 210	00	Transfer Command (Read) (ON: Start processing)	---	Read/ write
	01	Transfer Command (Write) (ON: Start processing)	---	
	02 to 15	*Reserved*	---	

Note 1. NetRef is the inverse of /NetRef (IR 209.00)

2. NetCtrl is the inverse of /NetCtrl (IR 209.01)

3. When /NetRef is turned OFF, the PLC is defining the Frequency Reference
When /NetRef is turned ON, the Inverter is defining the Frequency Reference
After power on the this bit is turned OFF (PLC reference)

4. When /NetCtrl is turned OFF, the PLC is controlling the Inverter
When /NetCtrl is turned ON, other sources are controlling the Inverter
After power on the this bit is turned OFF (PLC controlling)

⚠ **Caution** At power up, Inverter status flags in the following words toggle before they reflect the actual status of the Inverter:

- IR 200
- IR 205

Wait at least 2 PLC cycles before using these flags.

5-3 I/O Allocation DM

The contents of the DM area is refreshed and updated each PLC-cycle. Because the PLC-cycle is not synchronised with the Inverter-cycle and both are not the same in duration, it can take several PLC- or Inverter-cycles to update or refresh that data.

Word(s)	Function	Parameter	Read/ write
DM 2022	Specifies the Inverter operation in case a fatal error occurs in the program. (Leftmost 3 digits are invalid.). When last digit is other than 1: Data to Inverter is cleared continuously. When last digit is 1: Data to Inverter is frozen.	---	Read/ write
DM 2023	Destination address for storing transferred data (4 digits BCD): L (Note 1.)	---	Read/ write
DM 2024	Destination address for storing transfer response data (4 digits BCD): K (Note 1.)	---	Read/ write
DM 2025	Speed feedback (only when in Vector mode)	U1-05	Read-only
DM 2026	Torque reference (Unit: 0.1%)	U1-09	Read-only
DM 2027	PG counter value (Unit: 1 per edge)	---	Read-only
DM 2028	Frequency reference monitor (Unit: According to o1-03)	U1-01	Read-only
DM 2029	Output frequency monitor (Unit: According to o1-03)	U1-02	Read-only
DM 2030	Output current monitor (Unit: 0.01 A)	U1-03	Read-only
DM 2031	Multi-function analog input terminal (A2) monitor (Unit: 0.1%)	U1-16	Read-only
DM 2032	Main circuit DC voltage monitor (Unit: 1 V)	U1-07	Read-only
DM 2033	Multi-function analog input terminal (A3) monitor (Unit: 0.1%)	U1-17	Read-only
DM 2034	Analog frequency reference terminal (A1) monitor (Unit: 0.1%)	U1-15	Read-only
DM 2035	*Reserved*	---	Read-only
DM 2036	Frequency reference (Unit: According to o1-o3)	U1-01	Read/ write
DM 2037	Torque reference/torque limit	U1-09	Read/ write
DM 2038	Torque compensation	---	Read/ write
DM 2039	Analog output 1 (Unit: -1452 to 1452 Dec = -10 V to +10 V)	---	Read/ write
DM 2040	Analog output 2 (Unit: -1452 to 1452 Dec = -10 V to +10 V)	---	Read/ write

Note 1 The value (DM 0000 to DM 1985) is sampled when the Transfer Command Bit is turned ON.

5-3-1 Controlling Inverter I/O

Inputs

By default, all Inverter-inputs can be monitored in IR 204. However, they may have functionality attached to it. The function can be changed using H1-01..H1-10.

Note By setting the corresponding bit in IR 207 an input can be turned on.

Outputs

By default, Inverter-outputs can not be controlled by the PLC.

- To control the Multi-function outputs (Bits 0..4 in IR 208) the corresponding output setting (H2-01..H2-05) must be set to "F".
- To control the Analog outputs (DM 2039 and DM 2040) the corresponding output setting (H4-01 and H4-04) must be set to “1F”.

5-4 Transfer command

Parameters which are accessible through a corresponding MEMOBUS register inside the F7Z/E7Z/L7Z/G7C Inverter, can be accessed by using the Transfer command. Please check the Inverter manuals for more details.
The Transfer command is controlled by

- Two command bits: one for reading and one for writing
- Three status flags: busy-, completion- and error-flag
- Two DM area’s: one for specifying the command, one for specifying the response location.

All parameters accessed with the Transfer command use the register numbers and formats of the MEMOBUS-interface as defined by the F7Z/E7Z/L7Z/G7C Inverter.

Note Changes to parameters may not take effect immediately. Refer to the F7Z/E7Z/L7Z/G7C Manual for details.
When writing parameters to the Inverter, the parameters are temporarily stored in the parameter data area of the Inverter. To enable these parameters in the parameter data area the ENTER command must be used.
There are two types of ENTER commands:

- ENTER command that enables parameter data in RAM only (changes will be lost after power loss)
- ENTER command that writes data into the EEPROM (non-volatile memory) of the Inverter and enables the data in RAM at the same time.

The ENTER command is executed by writing 0 to the register numbers specified in the following table:

Register Address	Function
900h	Write parameter data to EEPROM, RAM is refreshed
910h	Parameter data are not written to EEPROM, but refreshed in RAM only.

Note ENTER command data can only be written.

5-4-1 Parameter Reading

To read the contents of an F7Z/E7Z/L7Z/G7C parameter, the corresponding Inverter register must be specified in the DM area specified by L (DM 2023). Refer to the F7Z/E7Z/L7Z/G7C manuals for the Inverter register definitions. A maximum number of 8 data items can be transferred in one operation.

Words	Function
L+0	Number of data words including L (binary)
L+1	Transfer destination Inverter register (4 digits binary)
L+2	Number of transferred data items (4 digits binary)

The response to the read command is stored in the DM area specified by K (DM 2024).
In case of a normal completion:

Words	Function
K+0	Number of data words including K (binary)
K+1	Transfer destination Inverter address 1 (4 digits binary)
K+2	Number of transferred data items 1 (4 digits binary)
K+3	Read data 1-1 (4 digits binary)
K+4	Read data 1-2 (4 digits binary)
K+5	…
K+6	…
K+7	…
K+8	…
K+9	…
K+10	…

In case of a completion which resulted in an error:

Words	Function
K+0	Number of data words including K (0002)
K+1	Error code (Note 1)

Note For the error codes see section 5-4-7.

5-4-2 Parameter Writing

To write an F7Z/E7Z/L7Z/G7C parameter, the corresponding Inverter register must be specified in the DM area specified by L (DM 2023). Refer to the F7Z/E7Z/L7Z/G7C manuals for the Inverter register definitions.
A maximum number of 8 data items can be transferred in one operation.

Words	Function
L+0	Number of data words including L (binary)
L+1	Transfer destination Inverter address (4 digits binary)
L+2	Number of transferred data items (4 digits binary)
L+3	Write data 1-1 (4 digits binary)
L+4	Write data 1-2 (4 digits binary)
L+5	…
L+6	…
L+7	…
L+8	…
L+9	…
L+10	…

Response data is stored in the DM area specified by K (DM 2024).
In case of a normal completion:

Words	Function
K+0	Number of data items (0002)
K+1	Normal response code (0000)

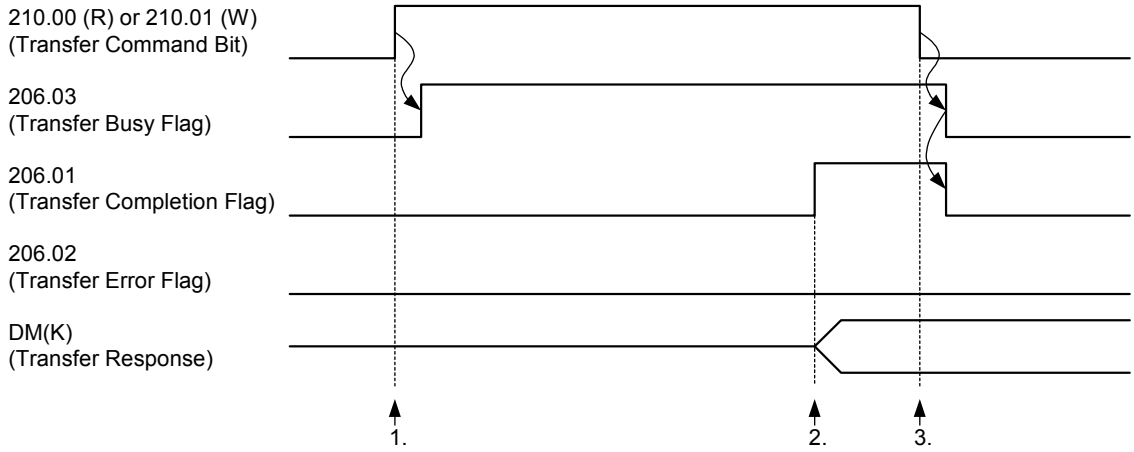
In case of a completion which resulted in an error:

Words	Function
K+0	Number of data items (0002)
K+1	Error code (Note 1.)

Note For the error codes see section 5-4-7.

5-4-3 Transfer Timing Chart

The diagram below shows the timing of the Transfer command with a normal completion. The timing is the same for reading and writing.



Operation

1. When the Transfer Command Bit is turned ON, the Transfer Busy Flag will turn ON one PLC cycle later, and the command specified in the DM Area (L) will be processed.
2. When the Transfer Completion Flag is turned ON, the response is present in the DM Area (K).
3. When the Transfer Command Bit is turned OFF, the Transfer Busy Flag and Transfer Completion Flag will turn OFF one PLC cycle later.

Timing

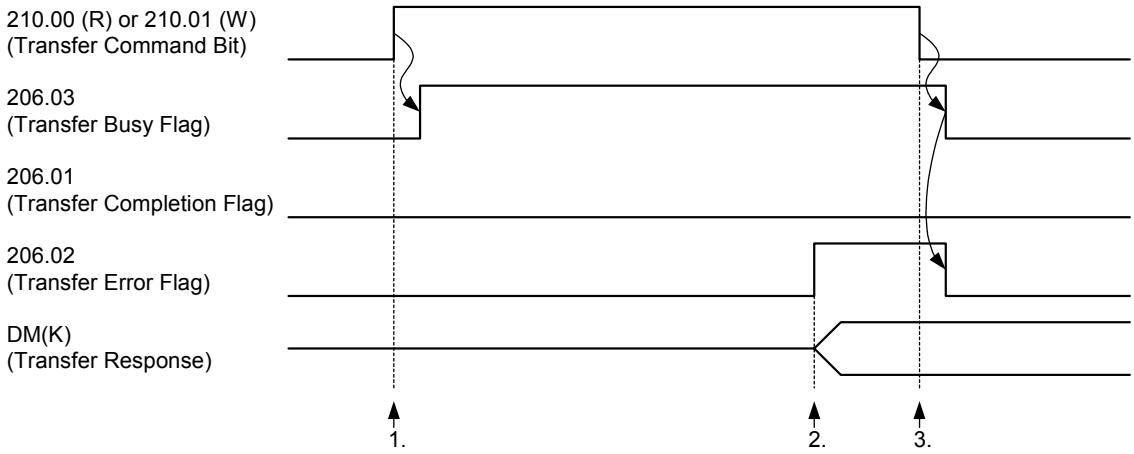
The time required for the Transfer command (between 1. and 2.) depends on the PLC cycle time and the speed of the Inverter-interface according the table below:

Minimum	Maximum
10 ms or 1 PLC-cycle	24 ms

In some occasions the time required is 1 second.

5-4-4 Transfer Timing Chart in case of Errors

The diagram below shows the timing of the Transfer command which resulted in an error. The timing is the same for reading and writing.



Operation

1. When the Transfer Command Bit is turned ON, the Transfer Busy Flag will turn ON one PLC cycle later, and the command specified in the DM Area (L) will be processed.

2. When the Transfer Error Flag is turned ON, the error code is present in the DM Area (K).

3. When the Transfer Command Bit is turned OFF, the Transfer Busy Flag and Transfer Error Flag will turn OFF one PLC cycle later.

Note In case of an error the Transfer Completion flag is not turned ON.

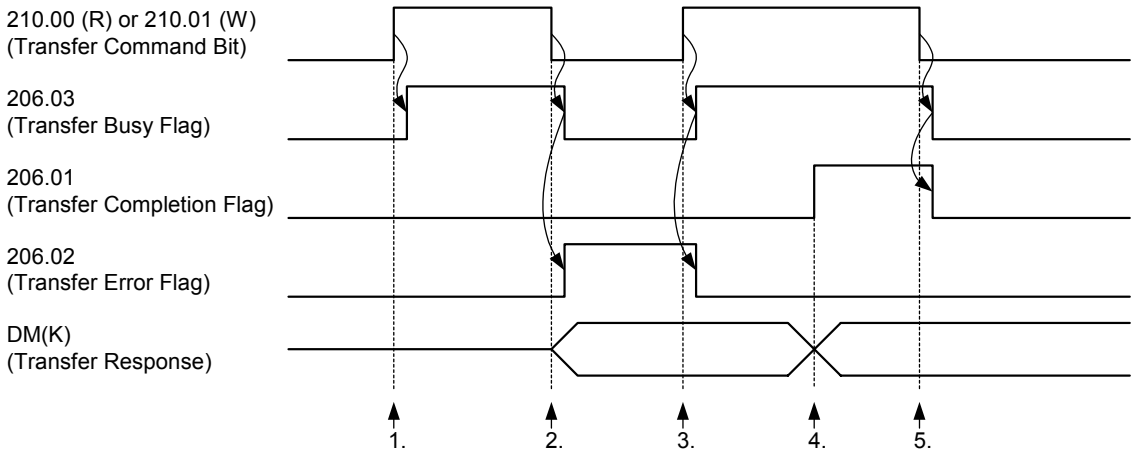
Note For the error codes see section 5-4-7.

Timing

The timing is the same as in the case of normal completion.

5-4-5 Transfer Timing Chart for Cancelling Processing

The diagram below shows the timing of the Transfer command in case the command is cancelled before completion. The timing is the same for reading and writing.



Operation

1. When the Transfer Command Bit is turned ON, the Transfer Busy Flag will turn ON, and the command specified in the DM Area (L) will be processed.

2. When the command is cancelled before completion, the Transfer Busy Flag will turn OFF and the Transfer Error Flag will turn ON.
The error code (0002) is present in the DM Area (K).

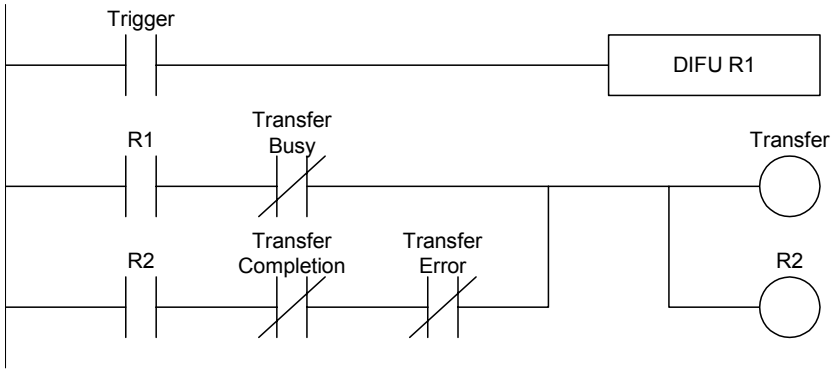
3. When the new Transfer Command Bit is turned ON, the Transfer Busy Flag will turn ON, and the command specified in the DM Area (L) will be processed. The Transfer Error Flag will turn OFF.

4. When the Transfer Completion Flag is turned ON, the response is present in the DM Area (K).

5. When the Transfer Command Bit is turned OFF, the Transfer Busy Flag and Transfer Completion Flag will turn OFF.

5-4-6 Transfer Ladder Program

The following ladder program can be used to transfer data from and to the Inverter:



5-4-7 Transfer Error Codes

Error code	Name	During reading	During writing
0001	Inverter response error	There was no response from the Inverter.	There was no response from the Inverter.
0002	Command bit OFF during transfer	The command bit turned OFF during transfer execution, and processing was aborted. (Note 1.)	The command bit turned OFF during transfer execution, and processing was aborted. (Note 1.)
0003	Transfer execution while busy	The transfer was executed during busy status.	The transfer was executed during busy status.
0004	Multiple start error	Writing and reading were both activated at the same time	Reading and writing were both activated at the same time
0010	CRC check error	The CRC for the read data did not agree.	The CRC for the response from the Inverter did not agree.
0200	Address error	An unused address was set.	An unused address was set.
0300	Data number error	An attempt was made to read more than 8 registers at the same time.	An attempt was made to write more than 8 registers at the same time
2100	Data setting error	-	The write data is not within the permissible range.
2200	Write error	-	An attempt was made during operation to write a constant that cannot be changed during operation. An attempt was made to overwrite read-only data.
2300	Write error (during UV)	-	An attempt was made to write a constant during UV.
2400	Write error (during processing)	-	An attempt was made to write constants when a write operation was already in progress for the constants.

Note 1 The situation is the same when the PLC mode is changed during a data transfer, except for cases where the status of output bits is retained when the mode is changed.

Note 2 When an error occurs it is not possible to determine exactly up to what point the data was properly received, so the data transfer must be restarted from the beginning.

Note 3 When the address K (reserved in DM) is not valid, it is not possible to write the error codes. Hence, only the error bit is set.

5-4-8 Operations with Command Bit Combinations

The table below shows the behaviour of the system when a command bit of one type (read or write) is set before clearing the previous command bit of the other type.

	Status			
	Transfer Command Bit 2	**Transfer Busy**	**Transfer Completion**	**Transfer Error**
Transfer Command Bit 1	Busy error occurs. Transfer operation is aborted.	Busy error occurs. Transfer operation is aborted.	Busy error occurs. Command is not executed.	Error is cleared and command is executed.

After the completion of a command the command bit must be cleared first before issuing the next command. Not clearing the command bit has the following consequences:

- Sending a write transfer command immediately after a read transfer command is processed.
- Sending a read transfer command immediately after a write transfer command is not processed.

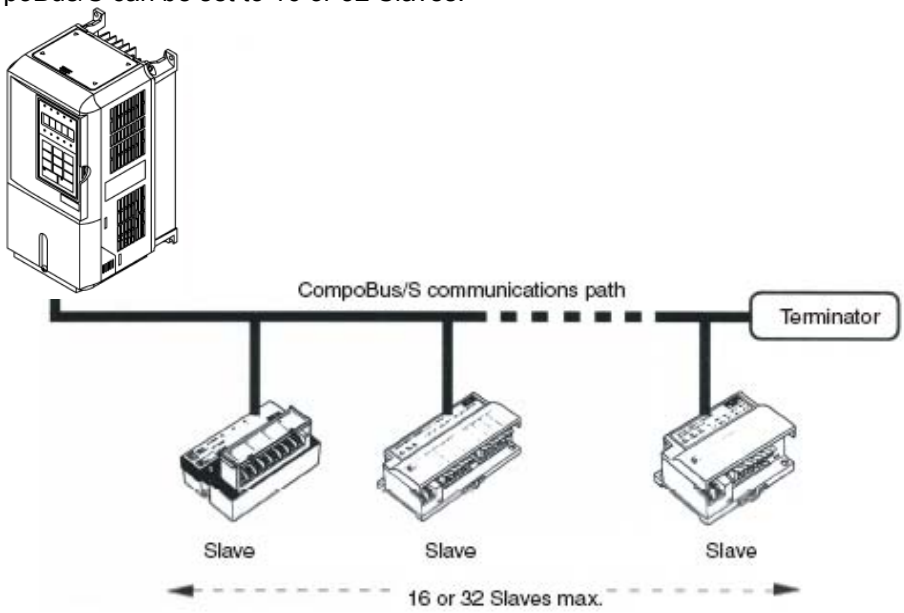
SECTION 6
Exchanging Data with CompoBus/S Slaves

This section explains how to exchange data with CompoBus/S Slaves when using the 3G3RV-P10ST as a CompoBus/S Master.
Read this section when using CompoBus/S I/O link communications.

6-1 Initial Settings

6-1-1 Setting the Maximum Number of Nodes

The maximum number of Slaves that can be connected through CompoBus/S can be set to 16 or 32 Slaves.



Use a Programming Device to set the maximum number of Slaves in DM 6603 of the PLC Setup, as shown in the following table.

Word	Bit(s)	Function		Settings	Default
DM 6603	00 to 03	Sets the max. number of CompoBus/S Slaves to 16 or 32.	0 (Hex): 32 Slaves 1 (Hex): 16 Slaves	0 or 1	0 (32 Slaves)

Note 1. Always turn the power OFF and ON again after changing this setting.

2. The communications response time is affected by the max. number of Slaves setting as shown below.

Communications mode	Max. number of Slaves	Communications response time
High-speed mode	16	0.5 ms
	32	0.8 ms
Long-distance mode	16	4.0 ms
	32	6.0 ms

6-1-2 Setting the CompoBus/S Communications Mode

The CompoBus/S communications mode can be set to high-speed mode or long-distance mode.

Communications mode	Max. communications distance (trunk line length)	Communications speed
High-speed mode	100 m	750 kbps
Long-distance mode	500 m	93.75 kbps

Use a Programming Device to set the maximum number of Slaves in DM 6603 of the PLC Setup, as shown in the following table.

Word	Bit(s)	Function		Settings	Default
DM 6603	04 to 07	Sets the CompoBus/S communications mode.	0 (Hex): High-speed mode 1 (Hex): Long-distance mode	0 or 1	0 (32 Slaves)

Note Always turn the power OFF and ON again after changing this setting.

6-2 Remote I/O Communications

6-2-1 Slaves

The following table lists the commonly used Slaves. Refer to the CompoBus/S Operation Manual for more details. The SRT1-series Slaves support high-speed communications mode only. The SRT2-series Slaves support both high-speed and long-distance communications modes.

Name	SRT2-series	SRT1-series
I/O Terminals (Transistor)	SRT2-ID04 SRT2-ID04-1 SRT2-ID08 SRT2-ID08-1 SRT2-ID16 SRT2-ID16-1 SRT2-ID16T SRT2-ID16T-1 SRT2-OD04 SRT2-OD04-1 SRT2-OD08 SRT2-OD08-1 SRT2-OD16 SRT2-OD16-1 SRT2-OD16T SRT2-OD16T-1 SRT2-MD16T SRT2-MD16T-1	SRT1-ID04 SRT1-ID04-1 SRT1-ID08 SRT1-ID08-1 SRT1-ID16 SRT1-ID16-1 Not available Not available SRT1-OD04 SRT1-OD04-1 SRT1-OD08 SRT1-OD08-1 SRT1-OD16 SRT1-OD16-1 Not available Not available Not available Not available
Connector Terminals (Transistor)	SRT2-VID08S SRT2-VID08S-1 SRT2-VID16ML SRT2-VID16ML-1 SRT2-ID32ML SRT2-ID32ML-1 SRT2-VOD08S SRT2-VOD08S-1 SRT2-VOD16ML SRT2-VOD16ML-1 SRT2-OD32ML SRT2-OD32ML-1 SRT2-MD32ML SRT2-MD32ML-1	Not available
Output Terminals (Relay outputs)	SRT2-ROC08 SRT2-ROC16	SRT1-ROC08 SRT1-ROC16
Output Terminals (Power MOSFET outputs)	SRT2-ROF08 SRT2-ROF16	SRT1-ROF08 SRT1-ROF16
I/O Modules	Not available	SRT1-ID16P SRT1-OD16P

Name	SRT2-series	SRT1-series
Analog Terminals	SRT2-AD04 SRT2-DA02	Not available
Sensor Amplifier Terminals	Not available	SRT1-TID04S SRT1-XID04S
Sensor Terminals	Not available	SRT1-ID08S SRT1-OD08S SRT1-ND08S
Bit-chain Terminal	Not available	SRT1-B1T
Environment Resistive Terminals	SRT2-ID04CL SRT2-ID04CL-1 SRT2-ID08 SRT2-ID08CL-1 SRT2-OD04CL SRT2-OD04CL-1 SRT2-OD08CL SRT2-OD08CL-1	Not available

6-2-2 I/O Allocation

In the 3G3RV-P10ST, CompoBus/S input words IR 020 to IR 027 and CompoBus/S output words IR 030 to IR 037 are allocated for the CompoBus/S Terminal's I/O. The CompoBus/S Terminal's I/O (IN0 to IN15 and OUT0 to OUT15) are allocated as indicated in the following table.
IN0 to IN15 are the node addresses for the Input Terminals and OUT0 to OUT15 are the node addresses for the Output Terminals.

Word		Relay numbers	
		Bit	
		15 14 13 12 11 10 9 8	7 6 5 4 3 2 1 0
Input	IR 020	IN1	IN0
	IR 021	IN3	IN2
	IR 022	IN5	IN4
	IR 023	IN7	IN6
	IR 024	IN9	IN8
	IR 025	IN11	IN10
	IR 026	IN13	IN12
	IR 027	IN15	IN14
Output	IR 030	OUT1	OUT0
	IR 031	OUT3	OUT2
	IR 032	OUT5	OUT4
	IR 033	OUT7	OUT6
	IR 034	OUT9	OUT8
	IR 035	OUT11	OUT10
	IR 036	OUT13	OUT12
	IR 037	OUT15	OUT14

Note 1. When the maximum number of CompoBus/S nodes is set to 16, IN8 to IN15 and OUT8 to OUT15 can be used as work bits.

2. CompoBus/S Terminals with less than 8 points are allocated bit addresses from either 0 or 8, filling up from the lowest available word.

3. CompoBus/S Terminals with 16 points can be set for only even number addresses.

6-3 Communications Status

The status of communications with CompoBus/S Terminals is indicated with the status flags in AR 04 through AR 07. Bits 0 to 7 contain the Active Slave Flags and bits 8 to 15 contain the Slave Communications Error Flags.

Word	Uppermost bits: Slave Communications Error Flags								Lower Bits: Active Slave Flags							
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AR04	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0
AR05	IN7	IN6	IN5	IN4	IN3	IN2	IN1	IN0	IN7	IN6	IN5	IN4	IN3	IN2	IN1	IN0
AR06	OUT15	OUT14	OUT13	OUT12	OUT11	OUT10	OUT9	OUT0	OUT15	OUT14	OUT13	OUT12	OUT11	OUT10	OUT9	OUT0
AR07	IN15	IN14	IN13	IN12	IN11	IN10	IN9	IN0	IN15	IN14	IN13	IN12	IN11	IN10	IN9	IN0

Note 1. IN0 to IN15 are the input terminals and OUT0 to OUT15 are the output terminals.

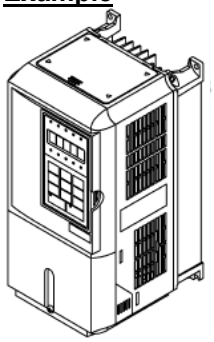
2. When the maximum number of CompoBus/S units is set to 16, IN8 to IN15 and OUT8 to OUT15 cannot be used.

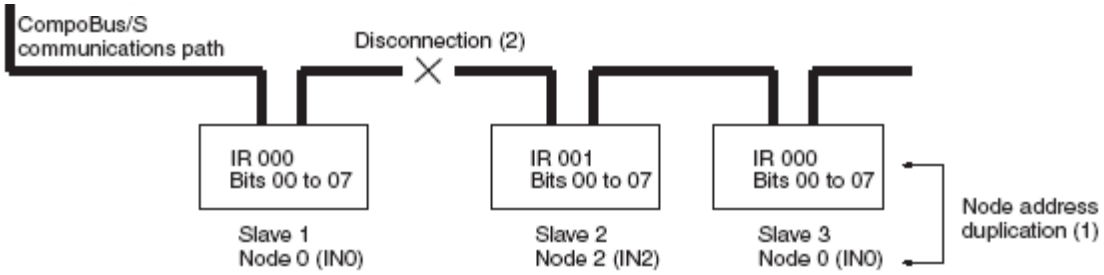
3. Each Active Slave Flag is turned ON when the corresponding Slave is participating in communications. When the power to the CPU Unit is turned OFF and ON again all of the Active Slave Flags are turned OFF.

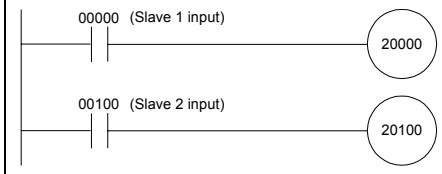
4. Each Slave Communications Error Flag is turned ON when a Slave that was participating in the network is separated from the network. The bit is turned OFF when the Slave re-enters the network.

5. An error is not generated at the 3G3RV-P10ST if there are duplicated node address settings for Slaves or if there is a communications error, such as communications failure or a disconnection. Therefore, use the above status flags in the ladder program to confirm whether or not node addresses are set correctly, and whether or not Slaves are operating correctly.

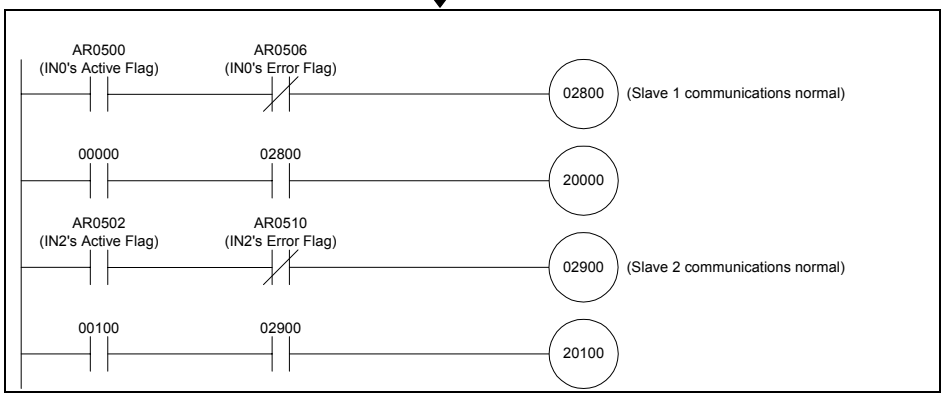
Example







If the addresses for Slave 1 and Slave 3 are the same, the Master will not be able to read input from Slave 3.
If a communications error is generated, the status of IR 00100 will be the same as before the error and so the change in the status of the actual input will not be detected.



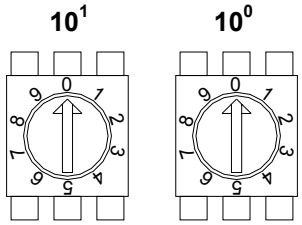
SECTION 7
Exchanging Data with a DeviceNet Master

This section explains how to exchange data with a DeviceNet Master. Refer to this section when using remote I/O communications or explicit message communications from a DeviceNet Master.

7-1 Initial Settings

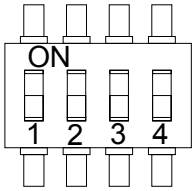
7-1-1 Setting the Node Number

Set the DeviceNet node number with the rotary switches on the PCB. The allowed setting range is 00 to 63; node number settings 64 to 99 are not allowed. The rotary switch settings are read when the Unit's power is turned ON.



7-1-2 Setting the Communications Speed

Set the DeviceNet communications speed with DIP switch 4 on the front of the Unit. The DIP switch settings are read when the Unit's power is turned ON.



DIP switch settings		DeviceNet communications speed	Maximum total communications distance
PIN 3	PIN 4		
OFF	OFF	125 kbps	500 m max.
ON	OFF	250 kbps	250 m max.
OFF	ON	500 kbps	100 m max.
ON	ON	Not used.	---

7-1-3 Attaching Status Information

It is possible to enable and disable the attachment of the 3G3RV-P10ST status information in transmissions from the 3G3RV-P10ST to the Master Unit.
The status attachment is set in DM 6605 of the PLC Setup, as shown in the following table. The initial setting is 0 (attach status information); change this setting to 1 to disable attachment of status information. Refer to 6-4 Status Information for details on the status information.

Word	Bits	Function	Default
DM 6605	04 to 07	Sets whether 3G3RV-P10ST status is transmitted to the DeviceNet Master. 0 (Hex): Attach status ahead of data. 1 (Hex): Do not attach status ahead of data.	0 (Attach status.)

7-2 Remote I/O Communications

Allocate the DeviceNet read and write areas to specify what part of the PLC's data area will be used to read and write data from the DeviceNet Master Unit.

Specify the PLC data area, starting word address, and number of bytes. Up to 64 bytes can be allocated for DeviceNet remote I/O.

Allocating Read/Write Areas with the PLC Setup

Switch the 3G3RV-P10ST to PROGRAM mode and use a Programming Device, such as a Programming Console or Support Software, to make the following settings in DM 6605 to DM 6609 of the PLC Setup. The settings in these words are read only when the 3G3RV-P10ST is turned ON, so the PLC's power must be turned OFF and then ON again to make changes effective.

Word	Bit(s)	Function		Default
DM 6605	00 to 03	DeviceNet Read/Write area setting 0 (Hex): Read (IN) IR 020 to IR 027; Write (OUT) IR 030 to IR 037 1 (Hex): Use settings in DM 6606 to DM 6609.		0 (Hex)
	05 to 07	Transmission of 3G3RV-P10ST status to the DeviceNet Master 0 (Hex): Attach status information ahead of data. 1 (Hex): Do not attach status information ahead of data.		0 (Hex)
	08 to 15	Not used.		0 (Hex)
DM 6606	00 to 07	DeviceNet I/O Link Write (OUT) area settings (Master → 3G3RV-P10ST)	Data area 01 (Hex): I/O area 1 (IR 000 to IR 049) 02 (Hex): I/O area 2 (IR 200 to IR 227) 03 (Hex): DM area (DM 0000 to DM 2047) 04 (Hex): LR area (LR 00 to LR 15) 05 (Hex): HR area (HR 00 to HR 19) 07 (Hex): Timer/counter area (TC 000 to TC 255)	00 (Hex)
	08 to 15		Number of bytes (see note 1) 01 to 40 (Hex) (equivalent to 1 to 64 decimal)	00 (Hex)
DM 6607	00 to 15		Starting word address 0000 to 07FF (Hex) (equivalent to 0000 to 2047 decimal)	0000 (Hex)
DM 6608	00 to 07	DeviceNet I/O Link Read (IN) area settings (3G3RV-P10ST → Master)	Data area 01 (Hex): I/O area 1 (IR 000 to IR 049) 02 (Hex): I/O area 2 (IR 200 to IR 227) 03 (Hex): DM area (DM 0000 to DM 2047) 04 (Hex): LR area (LR 00 to LR 15) 05 (Hex): HR area (HR 00 to HR 19) 06 (Hex): AR area (AR 00 to AR 23) 07 (Hex): Timer/counter area (TC 000 to TC 255)	00 (Hex)
	08 to 15		Number of bytes (see note 1) 01 to 40 (Hex) (equivalent to 1 to 64 decimal)	00 (Hex)
DM 6609	00 to 15		Starting word address 0000 to 07FF (Hex) (equivalent to 0000 to 2047 decimal)	0000 (Hex)

Note 1. A system failure error (PLC Setup setting error) will occur if the number of bytes is set to 00 (Hex) for both the write and read areas.

2. Data written through DeviceNet is valid even if the PLC is in PROGRAM mode, so outputs may go ON when the PLC is in PROGRAM mode if output bits are allocated to the DeviceNet I/O Link Write area. To prevent outputs from going ON while the PLC is in PROGRAM mode, do not allocate output bits directly to the DeviceNet I/O Link Write area.

3. If words in any areas other than the IR area (IR 000 to IR 227) or LR area (LR 00 to LR 15) are allocated to the I/O Link Read area, the data may not be cleared even when the power is interrupted, possibly causing data from immediately before power interruption to be read by the master. If this creates a potential problem, use the following measures to eliminate the problem.

- When starting in RUN or MONITOR mode, configure the ladder program so that the Read area is rewritten with appropriate data.
- When starting in PROGRAM mode, it will not be possible to take direct measures at the slave. Monitor the status at the master and do not read the data when the operating mode is PROGRAM mode.

When a fatal error occurs at a slave, the master may read data from immediately before the error. In this case also, monitor the status at the master and do not read the data.

Allocating Read/Write Areas with the DeviceNet Configurator

An OMRON DeviceNet Configurator (version 2.0 or higher) can be used to specify the DeviceNet Read and Write areas. Contact your OMRON representative if you are using a Configurator version earlier than 2.0. (The version can be displayed in the Configurator's Help menu.)

First verify if the Unit is available in the Configurator (in the Communications Adapter section). If it is not, it has to be installed first.
To do this, the following files are required:

- 3G3RV-P10ST8-DRT-E.EDS: DeviceNet Electronic data Sheet
- 3G3RV-P10ST8-DRT-E.ICO: Icon-file with a representation of the Inverter
- 3G3RV-P10ST8-DRT-E.INF: Expansion Module set file, necessary to add the Unit to the Configurator.

Installing expansion module

To install the expansion module, use the following procedure:

1,2,3... **1.** Select ***Option*** and ***Install Plugin Module***
A window to specify the name of the expansion module set file will be displayed.

2. Input the file name (3G3RV-P10ST8-DRT-E.INF) and click the Open Button.
The Expansion Module will be added to the Configurator.

Changing DeviceNet Parameters

To change DeviceNet parameters of the unit do the following:

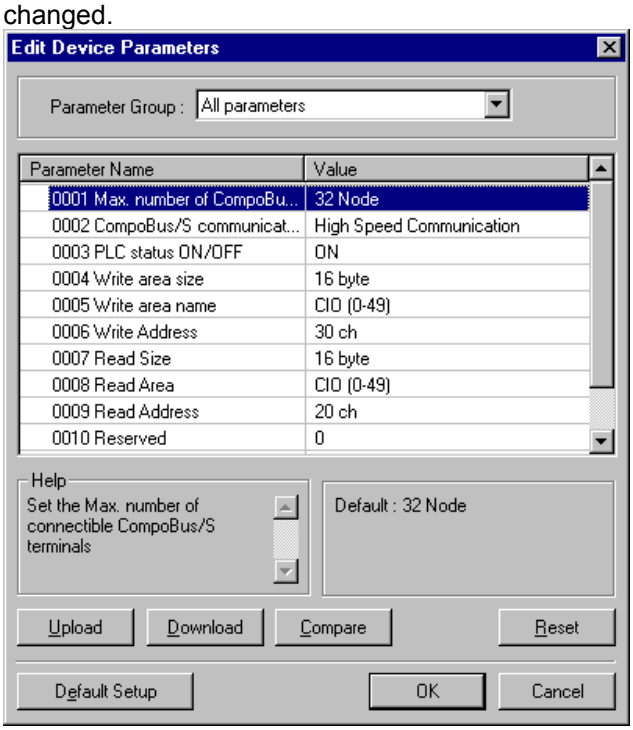
1,2,3... **1.** Connect the DeviceNet Configurator to the DeviceNet network and switch to online operation.

2. Turn ON the Inverter and put the PLC in PROGRAM mode.

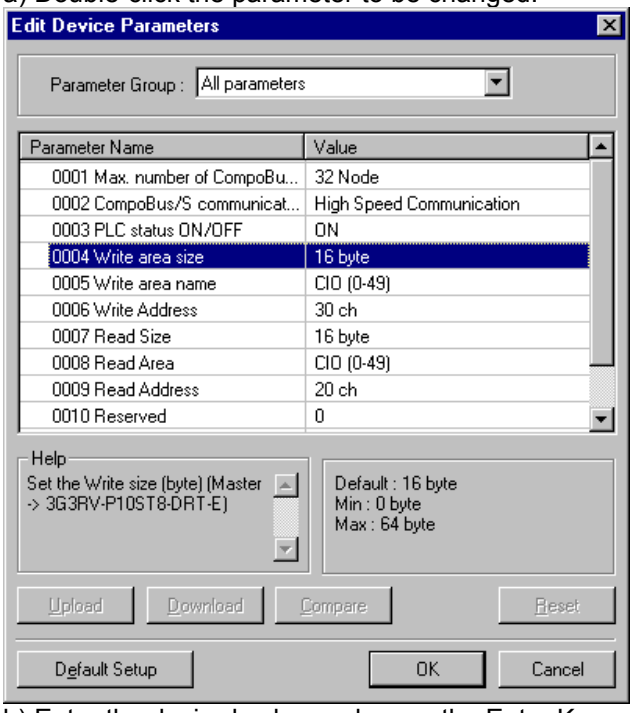
3. Click the Upload Button.

4. Double-click the 3G3RV-P10ST to be set on the DeviceNet Configurator's device list.

5. The DeviceNet Parameters Window will be displayed to edit the read and write area parameters. Double-click the read/write area parameters to be changed.



6. Change the parameters as shown in the following example.
a) Double-click the parameter to be changed.



b) Enter the desired value and press the Enter Key.

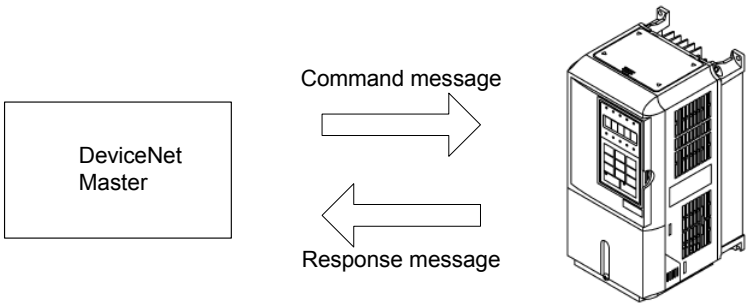
7. When all parameters are set as required, click the Download Button.

8. After the download has been completed, click the OK Button to return to the list display.

7-3 Explicit Message Communications

7-3-1 DeviceNet Explicit Message Functions

Explicit message communications use a command/response protocol. The 3G3RV-P10ST returns responses to commands sent from the Master, allowing 3G3RV-P10ST data areas to be read or written from the Master.



Explicit Message List

Explicit message	Function	Page
READ BYTE DATA	Reads the specified node's data in byte-units from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 200 bytes can be read at one time.	81
WRITE BYTE DATA	Writes data from the DeviceNet Master to the specified node's data area in byte-units. When word data is being written, the leftmost byte is written before the rightmost byte. Up to 200 bytes can be written at one time.	82
READ WORD DATA	Reads the specified node's data in word-units (two-byte units) from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 100 words can be read at one time.	84
WRITE WORD DATA	Writes data from the DeviceNet Master to the specified node's data area in word-units (two-byte units). When word data is being written, the leftmost byte is written before the rightmost byte. Up to 100 words can be written at one time.	85
ERROR RESPONSE	The 3G3RV-P10ST returns an error response when there is an error in the explicit message command sent from the DeviceNet Master.	86

Note 1. When sending explicit message commands, the range of data specified by the data area, starting address, and number of bytes must not exceed the range of the 3G3RV-P10ST data area.

2. Use the READ BYTE DATA and WRITE BYTE DATA commands when sending explicit message commands from an OMRON DeviceNet Master. Use the READ WORD DATA and WRITE WORD DATA commands when sending explicit message commands from another company's DeviceNet Master.

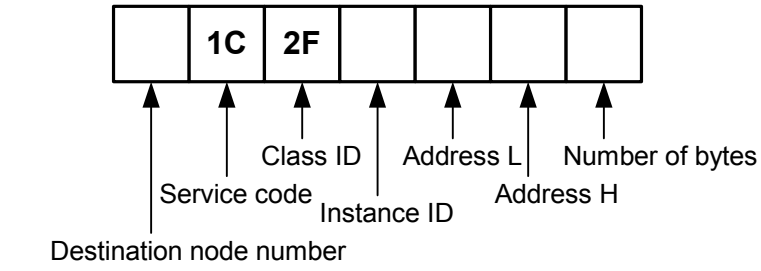
3. The number of bytes occupied by the "Class ID" and "Instance ID" parameters varies from Master to Master. These parameters are specified in 2 bytes (4 digits) in commands sent from OMRON DeviceNet Masters. (CV-series PLC's use the CMND instruction and C200HX/HG/HE PLCs use the IOWR instruction.)

7-3-2 Command and Response Formats

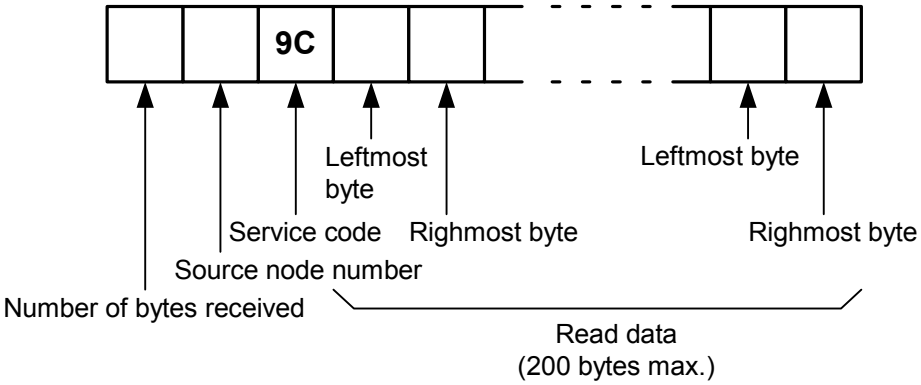
READ BYTE DATA

Reads the specified node's data in byte-units from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 200 bytes can be read at one time.

Command Format



Response Format



Parameters

Destination node number (command)

Specify the node number of the 3G3RV-P10ST containing the desired data in 1 byte (2-digit hexadecimal).

Service code (command, response)

Specify 1C (Hex) in the command.

The leftmost bit of the service code is turned ON in the response, so 9C (Hex) is returned.

Class ID (command)

Always 2F (Hex).

Instance ID (command)

Specify the data area containing the desired data in 1 byte (2-digit hexadecimal). Use one of the codes listed in the following table.

Code	Area name	Address range
01 (Hex)	IR Area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
06 (Hex)	AR area	AR 00 to AR 23 (read area only)
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)

Specify the starting word address of the read data in hexadecimal as follows:

Address L: The rightmost two digits of the 4-digit starting address.

Address H: The leftmost two digits of the 4-digit starting address.

Number of bytes (command)

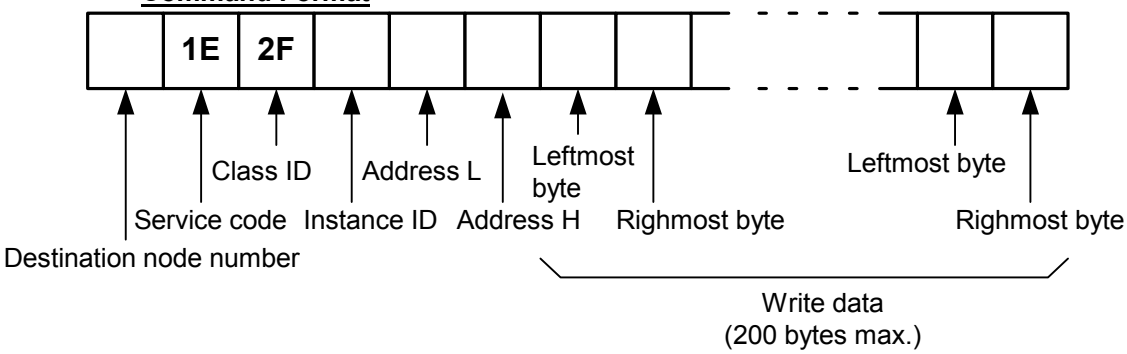
Specify the number of bytes of data to read in 1 byte (2-digit hexadecimal). The allowed range is 01 to C8 (Hex), which is equivalent to 1 to 200 decimal.

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the "source node number" on.
Source node number (response)
Indicates the node number (in hexadecimal) of the 3G3RV-P10ST that returned the response.
Read data (response)
Contains the desired data read from the specified data area. Word data is returned with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7). If an odd number was specified in the command's "number of bytes" parameter, the last byte of read data will contain the leftmost byte of a word.
Precautions
The range of data specified by the data area (instance ID), starting address (Address L and Address H), and number of bytes parameters must not exceed the range of the 3G3RV-P10ST data area.

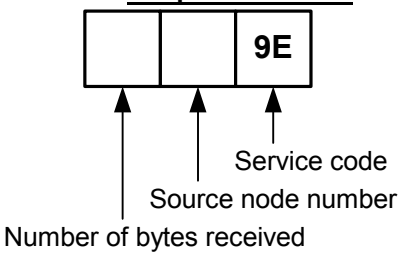
WRITE BYTE DATA

Writes data from the DeviceNet Master to the specified node's data area in byte-units. When word data is being written, the leftmost byte is written before the rightmost byte. Up to 200 bytes can be written at one time.

Command Format



Response Format



Parameters
Destination node number (command)
Specify the node number of the 3G3RV-P10ST where the data will be written. Specify the node number in 1 byte (2-digit hexadecimal).
Service code (command, response)
Specify 1E (Hex) in the command.
The leftmost bit of the service code is turned ON in the response, so 9E (Hex) is returned.
Class ID (command)
Always 2F (Hex).

Instance ID (command)
Specify the data area where data will be written. Specify one of the codes listed in the following table in 1 byte (2-digit hexadecimal).

Code	Area name	Address range
01 (Hex)	IR Area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)
Specify the starting word address where data will be written. Specify the address in hexadecimal as follows:

Address L: The rightmost two digits of the 4-digit starting address.
Address H: The leftmost two digits of the 4-digit starting address.

Write data (command)
Contains the data that will be written in the specified data area. Input word data with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7). If the command contains an odd number of bytes of write data, the last byte will be written to the leftmost byte of the last word.

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the “source node number” on.

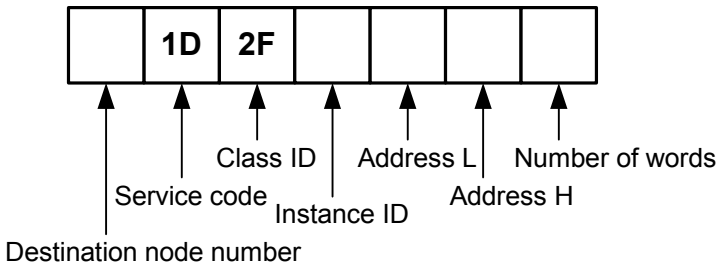
Source node number (response)
Indicates the node number (in hexadecimal) of the 3G3RV-P10ST that returned the response.

Precautions
The range of data specified by the data area (instance ID), starting address (Address L and Address H), and write data parameters must not exceed the range of the 3G3RV-P10ST data area.

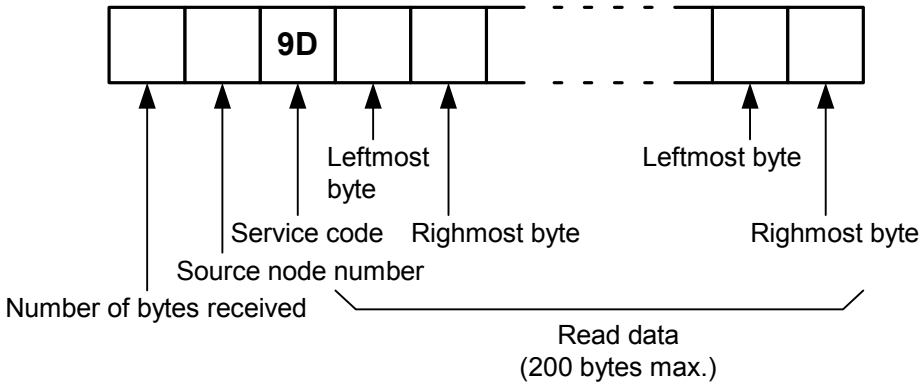
READ WORD DATA

Reads the specified node's data in word-units (two-byte units) from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 100 words can be read at one time.

Command Format



Response Format



Parameters

Destination node number (command)

Specify the node number of the 3G3RV-P10ST containing the desired data in 1 byte (2-digit hexadecimal).

Service code (command, response)

Specify 1D (Hex) in the command.

The leftmost bit of the service code is turned ON in the response, so 9D (Hex) is returned.

Class ID (command)

Always 2F (Hex).

Instance ID (command)

Specify the data area containing the desired data in 1 byte (2-digit hexadecimal). Use one of the codes listed in the following table.

Code	Area name	Address range
01 (Hex)	IR Area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
06 (Hex)	AR area	AR 00 to AR 23 (read area only)
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)

Specify the starting word address of the read data in hexadecimal as follows:

Address L: The rightmost two digits of the 4-digit starting address.

Address H: The leftmost two digits of the 4-digit starting address.

Number of words (command)

Specify the number of words of data to read in 1 byte (2-digit hexadecimal). The allowed range is 01 to 64 (Hex), which is equivalent to 1 to 100 decimal.

Number of bytes received (response) Indicates the number of bytes of data (in hexadecimal) from the "source node number."

Source node number (response)

Indicates the node number (in hexadecimal) of the 3G3RV-P10ST that returned the response.

Read data (response)

Contains the desired data read from the specified data area. Word data is returned with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7).

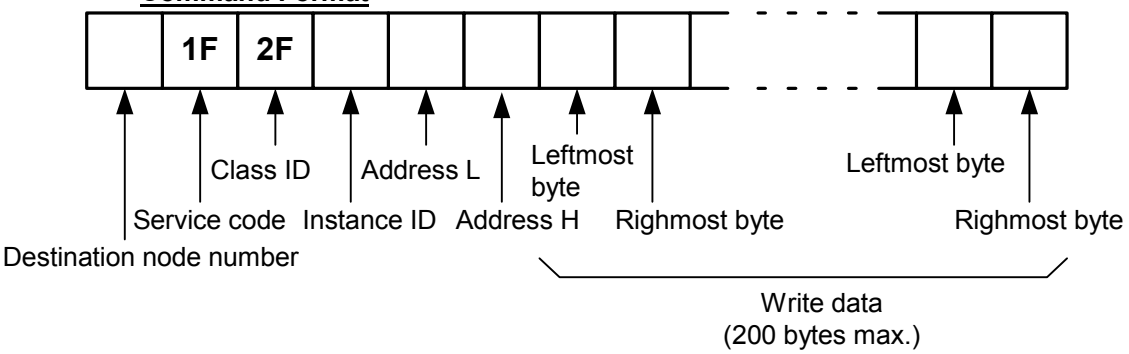
Precautions

The range of data specified by the data area (instance ID), starting address (Address L and Address H), and number of words parameters must not exceed the range of the 3G3RV-P10ST data area.

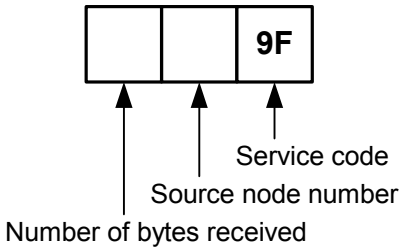
WRITE WORD DATA

Writes data from the DeviceNet Master to the specified node's data area in word-units (two-byte units). When word data is being written, the leftmost byte is written before the rightmost byte. Up to 100 words can be written at one time.

Command Format



Response Format



Parameters

Destination node number (command)

Specify the node number of the 3G3RV-P10ST where the data will be written. Specify the node number in 1 byte (2-digit hexadecimal).

Service code (command, response)

Specify 1F (Hex) in the command.

The leftmost bit of the service code is turned ON in the response, so 9F (Hex) is returned.

Class ID (command)

Always 2F (Hex).

Instance ID (command)
Specify the data area where data will be written. Specify one of the codes listed in the following table in 1 byte (2-digit hexadecimal).

Code	Area name	Address range
01 (Hex)	IR Area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)
Specify the starting word address where data will be written. Specify the address in hexadecimal as follows:
Address L: The rightmost two digits of the 4-digit starting address.
Address H: The leftmost two digits of the 4-digit starting address.

Write data (command)
Contains the data that will be written in the specified data area. Input word data with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7).

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the “source node number” on.

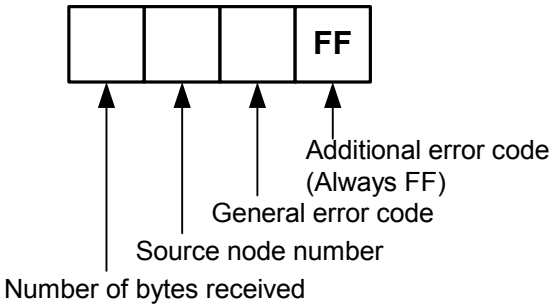
Source node number (response)
Indicates the node number (in hexadecimal) of the 3G3RV-P10ST that returned the response.

Precautions
The range of data specified by the data area (instance ID), starting address (Address L and Address H), and write data parameters must not exceed the range of the 3G3RV-P10ST data area.

ERROR RESPONSE

The 3G3RV-P10ST returns an error response when there is an error in the explicit message command sent from the DeviceNet Master.

Response Format



Parameters

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the “source node number.”

Source node number (response)
Indicates the node number (in hexadecimal) of the 3G3RV-P10ST that returned the response.

General error code (response)
Indicates the nature of the error with one of the 1-byte (2-digit hexadecimal) error codes listed in the following table.

Code	Error name	Meaning
08 (Hex)	Service not supported	The service code was invalid.
15 (Hex)	Too much data	There was too much data. (For example, the amount of write data exceeded the data area boundary.)
13 (Hex)	Not enough data	There was too little data. (For example, an odd number of bytes of write data were used in a WRITE WORD DATA command.)
20 (Hex)	Invalid parameter	The starting word address was invalid.
11 (Hex)	Reply data too large	The data area boundary was exceeded in a DATA READ command.
16 (Hex)	Object does not exist	The class ID or instance ID was invalid

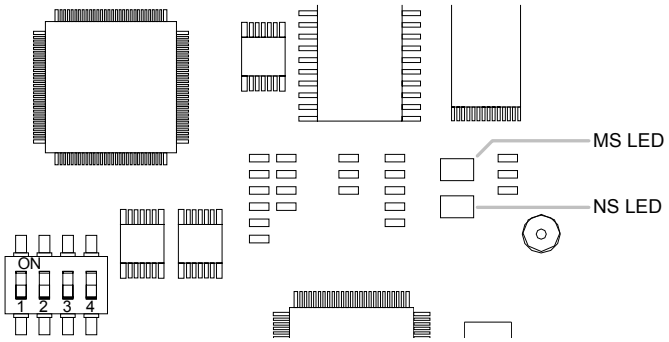
Additional error code (response)
Always FF (Hex).

7-4 Status Information

The status of DeviceNet communications is indicated by the 3G3RV-P10ST PLC's LED indicators and AR area flags. In addition, the PLC Setup can be set so that the 3G3RV-P10ST PLC's operating status information is attached to remote I/O transmissions from the 3G3RV-P10ST to the Master Unit.

7-4-1 LED Indicators

The status of DeviceNet communications is indicated on the 3G3RV-P10ST PLC's LED indicators.



Indicator	Colour	Status	Function	Meaning
MS	Green	ON	Normal status	Normal status
		Flashing	Incomplete settings status	Reading switch settings
	Red	ON	Fatal error	Hardware error (watchdog timer error)
		Flashing	Non-fatal error	Error such as incorrect switch settings
	---	OFF	Power is not being supplied.	• Power is not being supplied. • Waiting for initialisation to start • Reset in progress
NS	Green	ON	Online/Communications established	Normal network status when communications have been established
		Flashing	Online/Communications not established	Normal network status when communications haven't been established
	Red	ON	Fatal communications error	Communications error (The Unit detected an error indicating that network communications are disabled.) • Node number duplication • Bus off error detected
		Flashing	Non-fatal communications error	Communications timeout
	---	OFF	Offline/Power supply OFF	Waiting for completion of the node number duplication check in the Master. • Incorrect switch settings • Power supply OFF

7-4-2 AR Area Flags indicating DeviceNet Status

The following status information is output to flags in the AR area.

Word	Bit(s)	Function	
AR 00	00	DeviceNet switch settings error (ON when a settings error occurred, OFF when normal.)	
	01	Node number duplication or Bus off error (ON when an error occurred, OFF when normal.)	
	02	DeviceNet network power supply error (ON when an error occurred, OFF when normal.)	
	03	DeviceNet communications error (ON when an error occurred, OFF when normal.)	
	04 to 06	Not used.	
	07	DeviceNet status error (ON when an error occurred, OFF when normal.)	
	08	Explicit Connection Flag	ON: The connection has been established. OFF: The connection has not been established.
	09	Polling Connection Flag	
	10	Bit Strobe Connection Flag	
	11 to 14	Not used.	
	15	I/O Link in progress (ON when the I/O Link is operating, otherwise OFF.)	

7-4-3 3G3RV-P10ST Status Output to DeviceNet

The operating status of the 3G3RV-P10ST is transmitted to the Master Unit in two words. The status information is automatically attached as the first two words received at the Master.
The setting in DM 6605 bits 04 to 07 of the PLC Setup determines whether or not the status information will be transmitted.

Word	Bits	Function	Default
DM 6605	04 to 07	Sets whether 3G3RV-P10ST status is transmitted to the DeviceNet Master. 0 (Hex): Attach status ahead of data. 1 (Hex): Do not attach status ahead of data. (A settings error will occur for any other setting.)	0 (Attach status.)

Transmitted Status Information

<table>
<tr><th>Word</th><th>Bit(s)</th><th>Contents</th></tr>
<tr><td rowspan="7">Leading word</td><td>00 to 07</td><td>The error code (2 digits) that is output to AR 253 bits 00 to 07 is output</td></tr>
<tr><td>08 and 09</td><td>3G3RV-P10ST operating mode
<table><tr><th>Bit</th><th>09</th><th>08</th></tr><tr><td>PROGRAM mode</td><td>0</td><td>0</td></tr><tr><td>MONITOR mode</td><td>1</td><td>0</td></tr><tr><td>RUN mode</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>10</td><td>Not used.</td></tr>
<tr><td>11</td><td>UM area write-protection (Mirrors the status of PLC Setup setting in DM 6602 bits 00 to 03.)
OFF: UM writable
ON: UM write-protected</td></tr>
<tr><td>12 and 13</td><td>Not used.</td></tr>
<tr><td>14</td><td>ON when a non-fatal error has occurred.</td></tr>
<tr><td>15</td><td>ON when a fatal error has occurred.</td></tr>
<tr><td rowspan="14">Leading word + 1</td><td>00 to 03</td><td>Not used.</td></tr>
<tr><td>04</td><td>ON when a battery error has occurred.
(Effective only when detection of battery errors is enabled with the PLC Setup setting in DM 6655 bits 12 to 15 set to 0.)</td></tr>
<tr><td>05</td><td>ON when a cycle time overrun error has occurred.</td></tr>
<tr><td>06</td><td>Not used.</td></tr>
<tr><td>07</td><td>ON when FAL(06) was executed or a PLC Setup settings error has occurred.
(The FAL number is transmitted in bits 00 to 07 of the leading word.)</td></tr>
<tr><td>08</td><td>ON when a memory error has occurred.</td></tr>
<tr><td>09</td><td>ON when there isn't an END(01) instruction in the program.</td></tr>
<tr><td>10</td><td>Not used.</td></tr>
<tr><td>11</td><td>ON when an I/O Unit over error (too many Units) has been detected.</td></tr>
<tr><td>12 and 13</td><td>Not used.</td></tr>
<tr><td>14</td><td>ON when an I/O bus error has occurred.</td></tr>
<tr><td>15</td><td>ON when FALS(07) was executed.
(The FAL number is transmitted in bits 00 to 07 of the leading word.)</td></tr>
</table>

Note If words in any areas other than the IR area (IR 000 to IR 227) or LR area (LR 00 to LR 15) are allocated to the I/O Link Read area, the data may not be cleared even when the power is interrupted, possibly causing data from immediately before power interruption to be read by the master. If this creates a potential problem, use the following measures to eliminate the problem.

- When starting in RUN or MONITOR mode, configure the ladder program so that the Read area is rewritten with appropriate data.
- When starting in PROGRAM mode, it will not be possible to take direct measures at the slave. Monitor the status at the master and do not read the data when the operating mode is PROGRAM mode.

When a fatal error occurs at a slave, the master may read data from immediately before the error. In this case also, monitor the status at the master and do not read the data.

SECTION 8
Encoder interface

This section explains how to use the Encoder interface functionality.

8-1 Features and Functions

Counter Type

The 3G3RV-P10ST is equipped with an Encoder interface, able to count over a maximum binary range of 32-bits. Accepting input pulse frequencies of up to 50 kHz allows precise control of fast motions.

Input Signal Type

Depending on the type of input signal that your application requires, a choice can be made out of three input signal types:

- Phase Differential Inputs (multiplication by either 1, 2 or 4) (refer to 8-3-1 “Phase Differential”)
- Up/Down Pulse Inputs (refer to 8-3-2 “Up & Down")
- Pulse & Direction Inputs (refer to 8-3-3 “Pulse & Direction")

Capturing

Two standard digital inputs (00004 and 00005) or the Phase-Z input can be assigned to the Counter for capture functionality (refer to 8-4 "Capturing”).

Comparison

The current Counter value can be compared to a comparison value, resulting in the setting of a flag or an interrupt (refer to 8-5 “Comparison”).

Clearing Counter

The following sources can trigger a clear of the Counter (refer to 8-6 “Counter clear”):

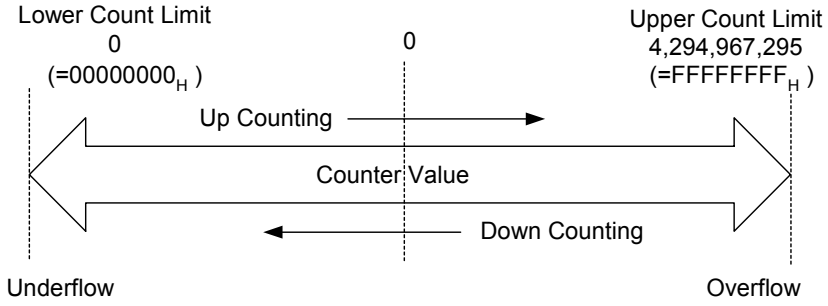
- Software bit in the PLC
- Phase-Z input

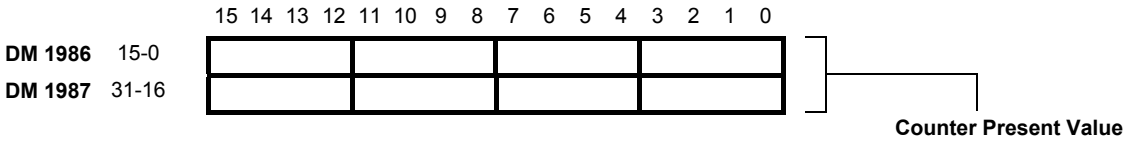
Interrupt

The counter supports 6 sources (flags) to generate an interrupt to the ladder program (see 8-7 “Interrupts”).

8-2 Counter Present value

The Counter has the full counting range (=32 bits) available to count up- or downwards between the Lower Count Limit (0) and the Upper Count Limit (4,294,967,295 or 2^{32}-1).





Counter Present Value

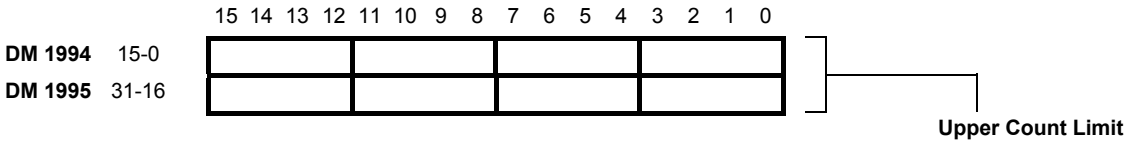
Range: between 00000000 H and FFFFFFFF H (2^{32}-1)

8-2-1 Upper count limit

Configuring Upper Count Limit

The Upper Count Limit can be configured between 0 and 4,294,967,295 (=FFFFFFFF$_H$). By default the Upper Count Limit is equal to 0.

The Counter automatically rolls over to 0 if the Counter Value exceeds the Upper Count Value and continues counting. If the Counter Value goes below 0 the Counter rolls over to the Upper Count Value and continues counting.



Upper Count Limit

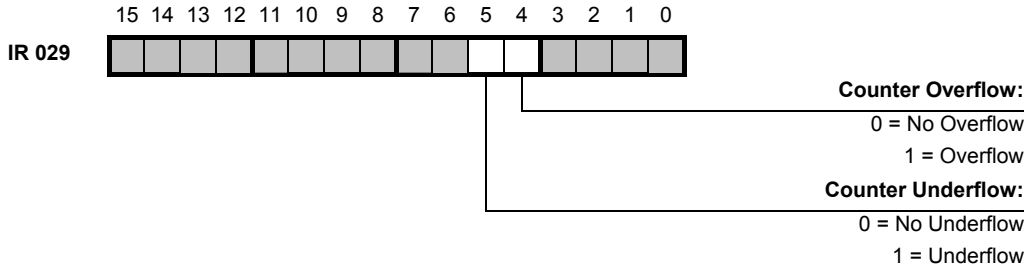
Set Upper Count Limit for Circular Counters between 00000000$_H$ and FFFFFFFF$_H$.

Per default (=00000000$_H$) the Upper Count Limit is equal to FFFFFFFF$_H$.

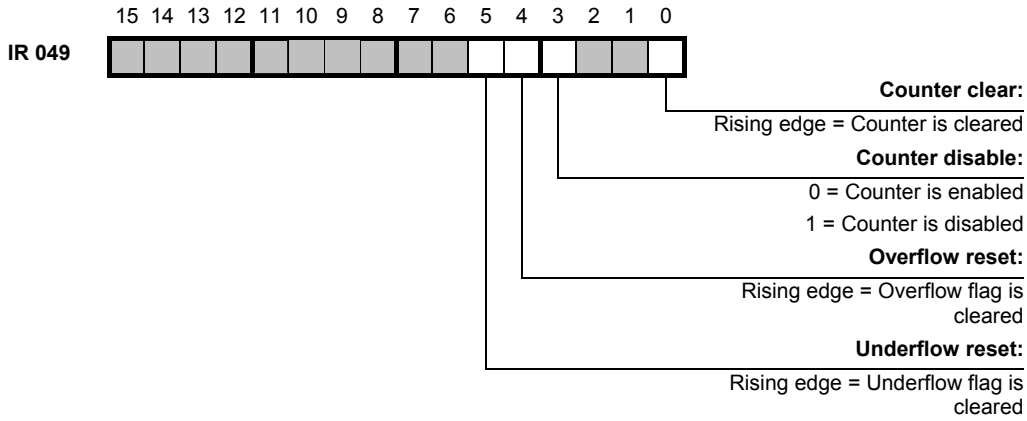
8-2-2 Counter clear, Counter enable, Over- and Underflow

Reporting Overflow and Underflow

If the Counter Value goes above the Upper Count Limit or below 0 an Overflow- and Underflow will be generated respectively. These are reported in IR.



The Counter can be cleared by using the Counter clear bit. The Over- and Underflow flags can be cleared by using the Over- and Underflow reset bits. The Counter can be enable and disabled with the Counter Disable bit.

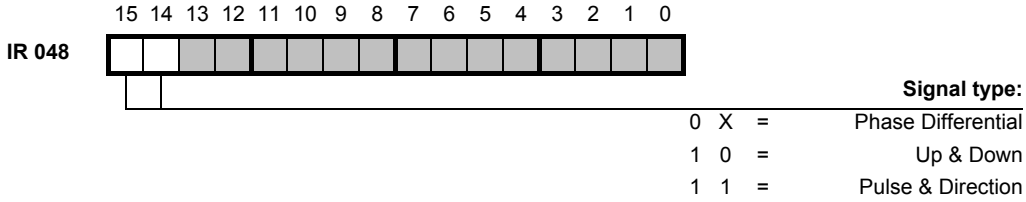


⚠ **Caution** The Counter clear and Over- and Underflow reset functions are executed when a rising edge is generated (0 → 1). Keep these bits high during 1 PLC cycle only.

It is prohibited to use the Counter clear and Over- and Underflow reset functions while the Phase-Z counter clear function is enabled (IR 049.02).

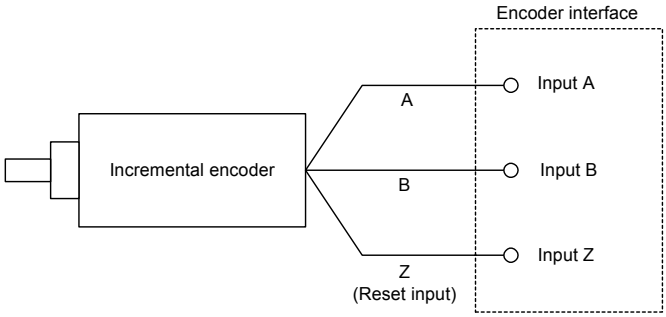
8-3 Input Signal Types

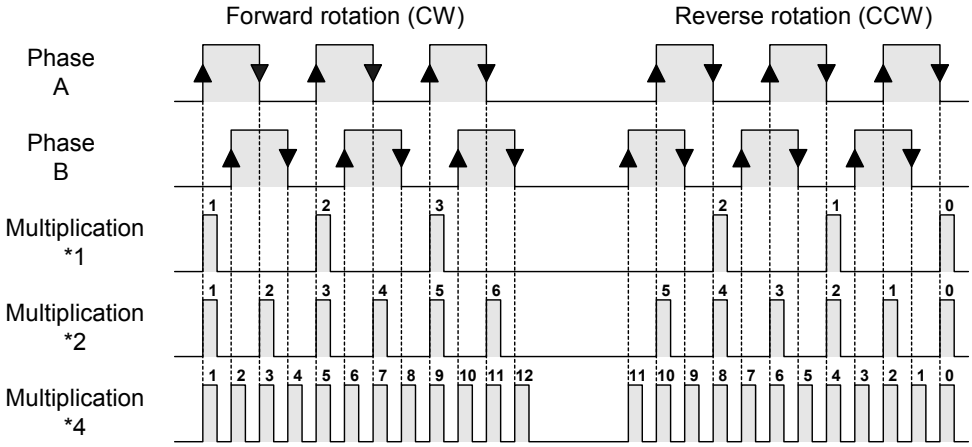
The type of input required for the application is selected by means of two bits in IR 048.



8-3-1 Phase Differential

Phase Differential Signals are connected to the inputs A, B and Z of the Encoder interface. The count direction is determined by the phase angle between input A and input B. If signal A leads to B, the counter increments. If signal B leads to A, the counter decrements.





Multiplication x1

By default the Counter is configured for Multiplication by 1. If the Counter is up-counting (signal A leads to signal B) pulses are taken into account by the Counter on the rising edges of signal A. If the Counter is down-counting pulses are taken into account on the falling edges of input A.

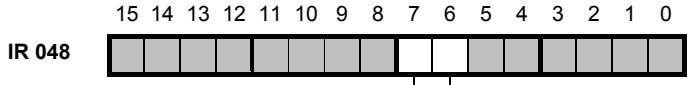
Multiplication x2

To increase the resolution of the incremental encoder the Counter can be configured for multiplication by 2. If the Counter is up-counting (signal A leads to signal B) pulses are taken into account by the Counter on the rising- and falling edges of signal A. If the Counter is down-counting pulses are also taken into account on the rising- and falling edges of signal A.

Multiplication x4

To further increase the resolution of the incremental encoder multiplication by 4 should be selected. If the Counter is up-counting (signal A leads to signal

B) pulses are taken into account by the Counter on the rising- and falling edges of signal A and signal B. If the counter is down-counting pulses are also taken into account on the rising- and falling edges of signal A and B.



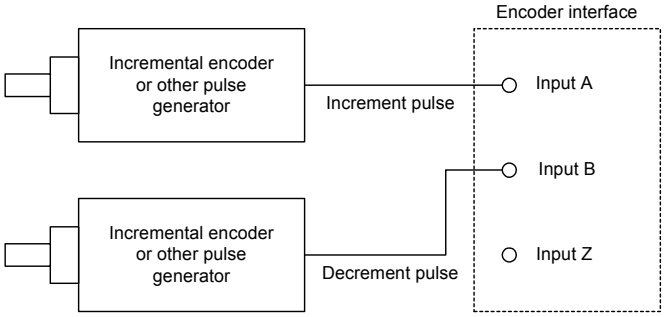
Multiplication:

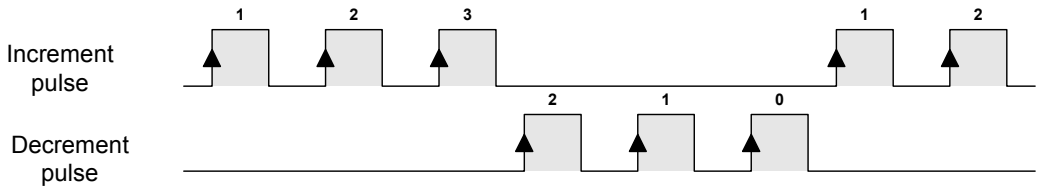
0	0	=	x1
0	1	=	x2
1	0	=	x4
1	1	=	Do not use

Note The settings above are enabled when Phase Differential mode is selected. In the other modes these settings are ignored.

8-3-2 Up & Down

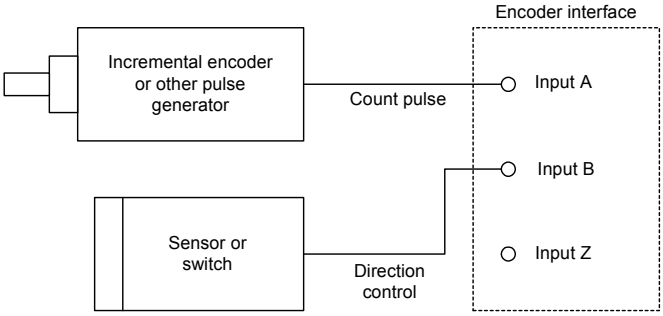
With this Signal Type the Counter increments on the rising edge of pulses applied to input A and decrements on the rising edge of pulses applied to input B.

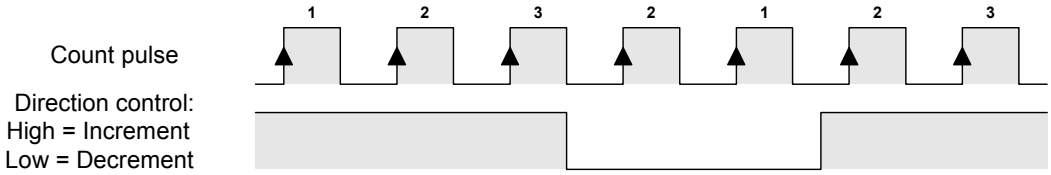




8-3-3 Pulse & Direction

In this configuration, count pulses are applied to input A. The direction of counting is controlled by the level of the signal applied to input B. If input B is high, the Counter increments on the rising edges of input A. If input B is low, the Counter decrements on the rising edges of input A.



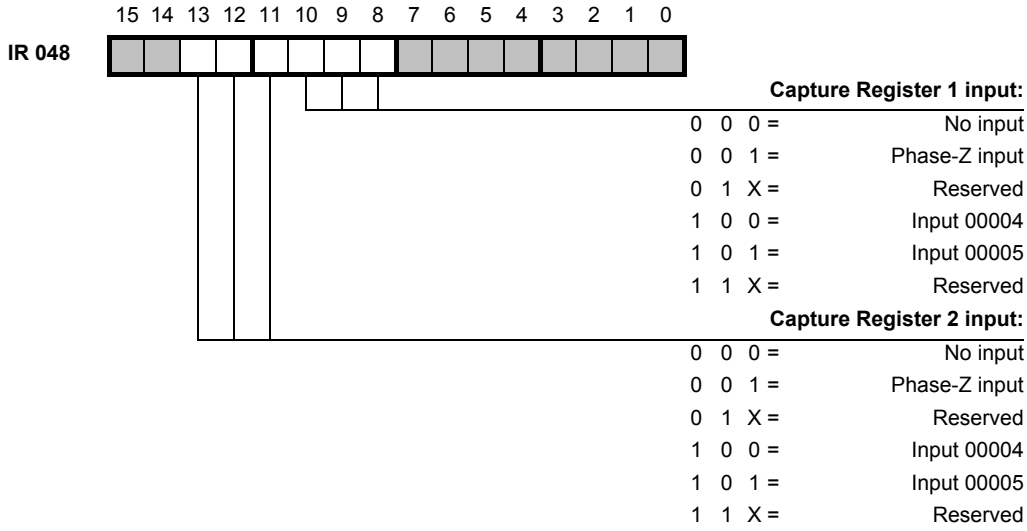


8-4 Capturing

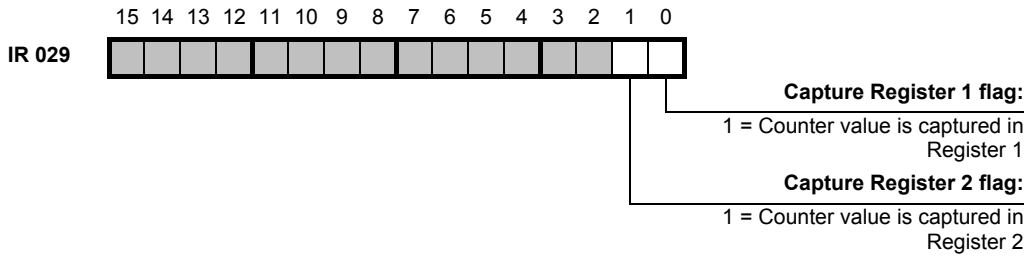
An input configured to have capture functionality will capture the current Counter Value into one of the two Capture Registers on a rising edge of the input signal. Every time a Counter Value is captured, the contents of the Capture Register are overwritten with the new Captured Value and the old Captured Value is lost.
The following inputs can be used to trigger the capturing function:

- Phase-Z input
- Input 00004
- Input 00005

Configuring is done in IR 048:

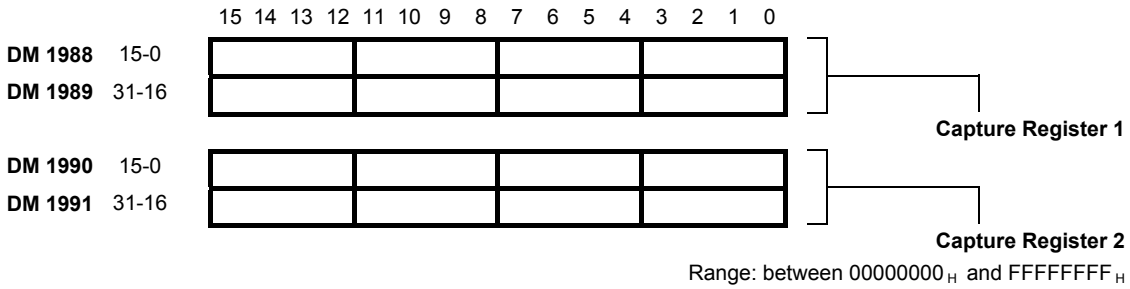


Two bits in IR will be set if Capturing has occurred:



Note The Capture Register flags are cleared automatically: the flags are active during one scan only.

The captured Counter value is stored in one of the Capture registers:



Range: between 00000000_H and $FFFFFFFF_H$

Response time

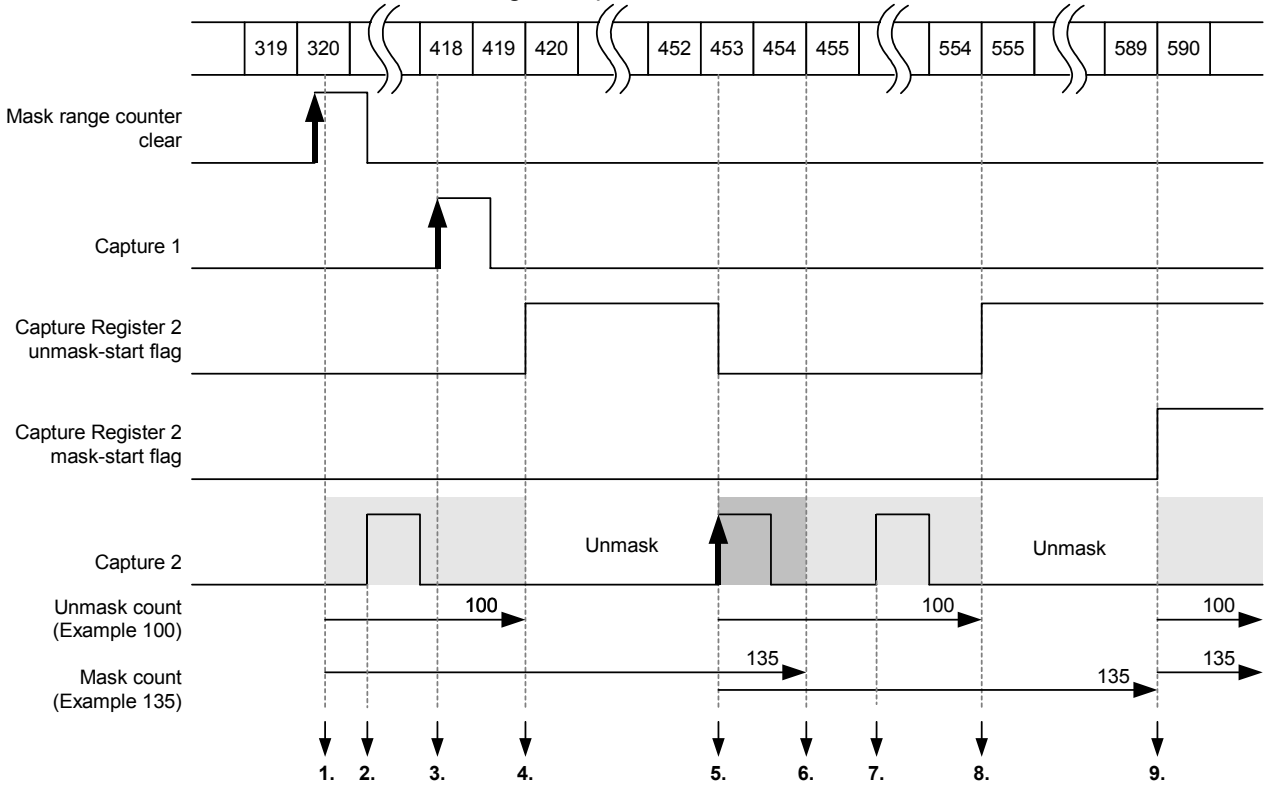
The following response times are defined for capturing:

- Input response time: delay between the input activated until the position is captured.
- Captured position transfer time: delay between the input activated until the captured position is available in the program.

Response time	Input	Value
Input	Phase-Z	3 μs
	00004	4 μs
	00005	
Captured position	Phase-Z	Minimum: 0.3 ms Maximum: 1 PLC-cycle + 0.4 ms
	00004	
	00005	

8-4-1 Capture mask range

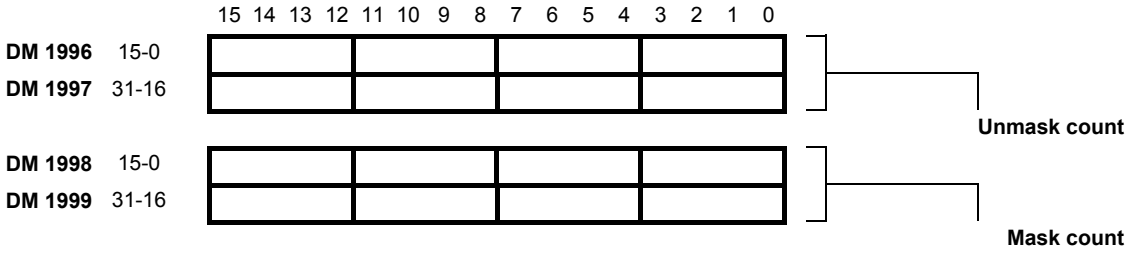
The capture signal for Capture register 2 can be masked in two ranges. A Mask range counter will count the number of pulses after it has been cleared. This is independent of the direction. First the capture input is masked until the Mask range counter is equal to the register specifying the start of the unmask-period (Unmask count register). The capture input is then unmasked until the Mask range counter is equal to the register specifying the start of the masking-period (Mask count register).
If the Counter value is captured during the unmask-period, the capture input is masked again, until the Mask range counter counts again the number of pulses specified in the Unmask count register.
If the Counter value is not captured during the unmask-period (no capture signal), the capture input is masked, until the Mask range counter counts the number of pulses specified in the Mask count register.
The following example shows the behaviour described above.



1. Mask range counter is cleared
2. Capture in register 2 ignored due to masking
3. Capture in register 1 (418) (masking only for register 2)
4. Masking ended after 100 counts (Unmask count register)
Capture Register 2 unmask-start flag is set
5. Capture in register 2 (453)
Because the counter value has been captured, the unmasked period until the Mask count period is canceled.
Capture Register 2 unmask-start flag is cleared
6. End of normal unmask period reached
7. Capture in register 2 ignored due to masking
8. Masking ended after 100 counts (Unmask count register)
Capture Register 2 unmask-start flag is set
9. End of unmask period reached
Capture Register 2 mask-start flag is set
New masking sequence is started.

Two parameters specify the masking range of the capture input of Capture register 2:

- Unmask count: number of counts after which the capture signal is unmasked.
- Mask count: number of counts after which the capture signal is masked.

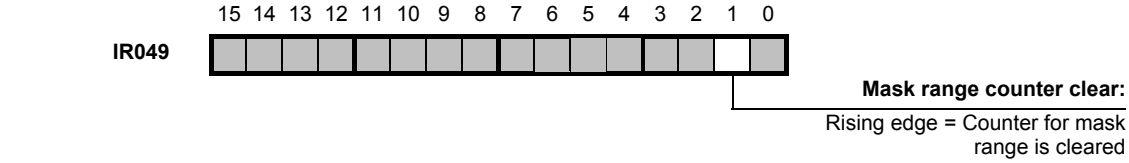


Note The Mask range parameters must be set according the following conditions:

$0 \leq$ Unmask count $<$ Mask count

If the Unmask count register is set to 0, the capture input will never be masked. In this case the behaviour of Capture registers 1 and 2 is the same.

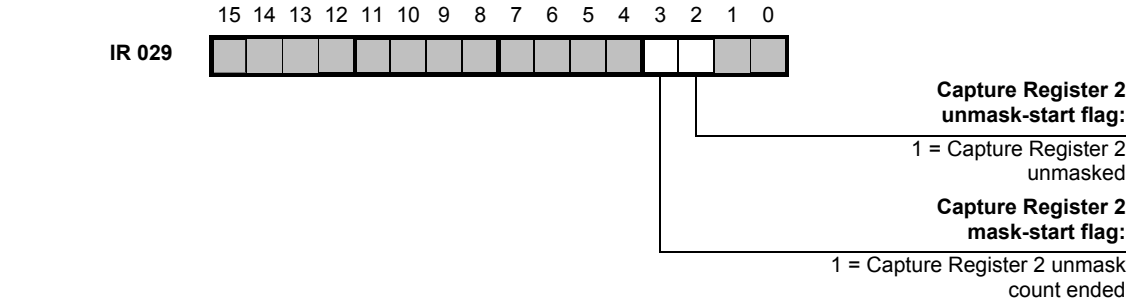
The Mask range counter can be cleared with the Mask range counter clear bit:



⚠ **Caution** The Mask range counter clear function is executed when a rising edge is generated (0 → 1). Keep this bit high during 1 PLC cycle only.

It is prohibited to use the Mask rang counter clear function while the Phase-Z counter clear function is enabled (IR 049.02).

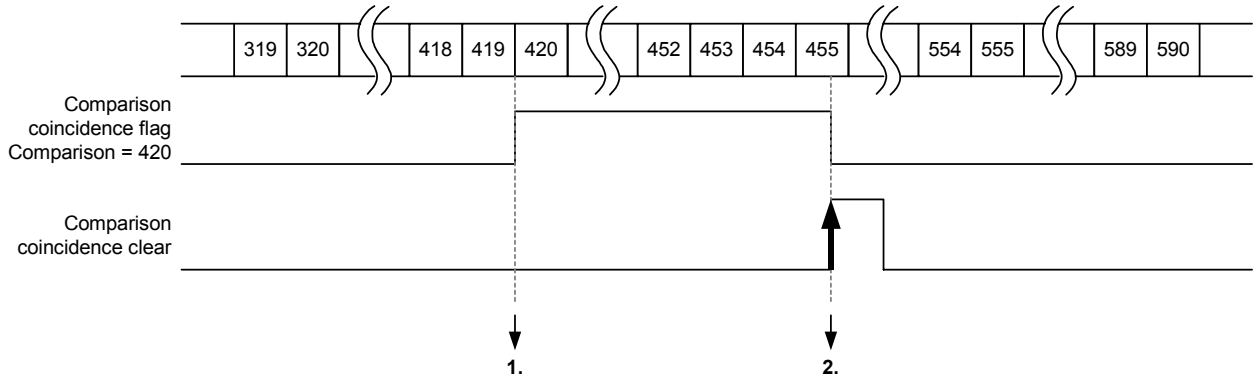
The following bits specify the status of the masking:



Note The Unmask- and Mask-start flags are active during 1 PLC cycle only.

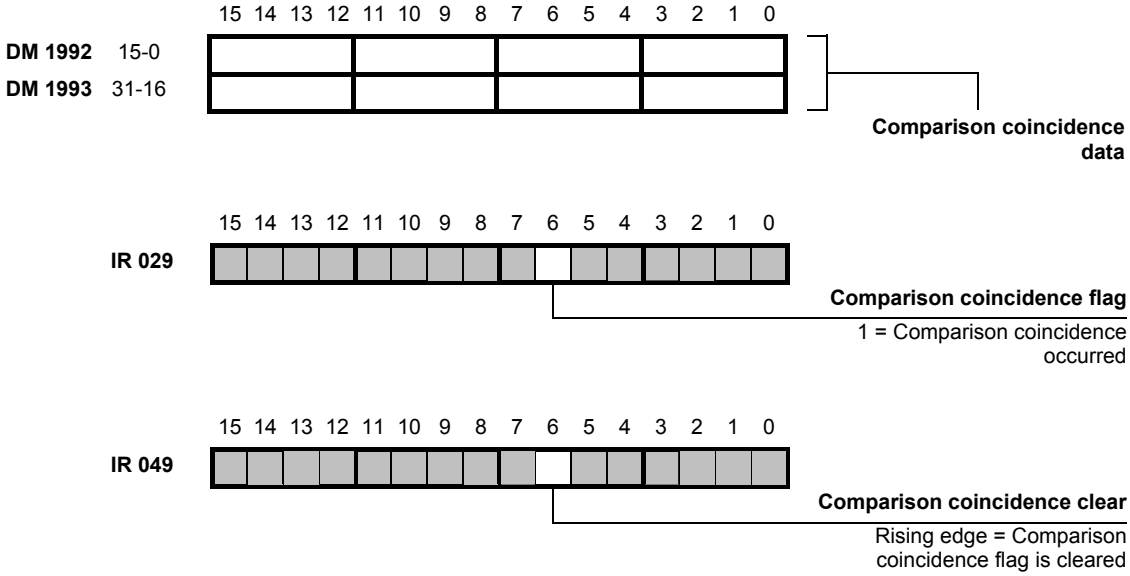
8-5 Comparison

The comparison function enables the current counter value to be compared with a preset value. When both values are the same, the Comparison coincidence flag is set. The flag is cleared with the Comparison coincidence clear bit.



1. Counter value is equal to the Comparison value
The Comparison coincidence flag is set

2. The Comparison coincidence clear bit is set, resulting in the Comparison coincidence flag to be reset.



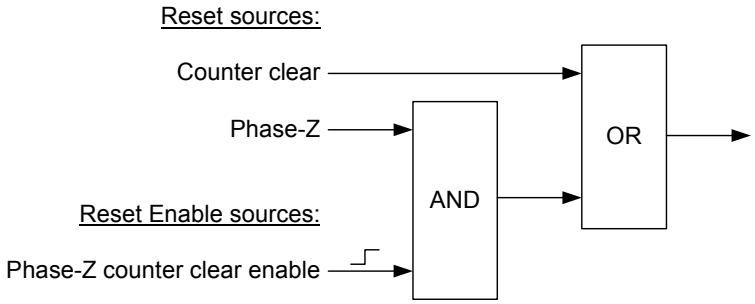
⚠ **Caution** The Comparison coincidence clear function is executed when a rising edge is generated (0 → 1). Keep this bit high during 1 PLC cycle only.

It is prohibited to use the Comparison coincidence clear function while the Phase-Z counter clear function is enabled (IR 049.02).

8-6 Counter clear

The following sources can clear the Counter Value to zero:

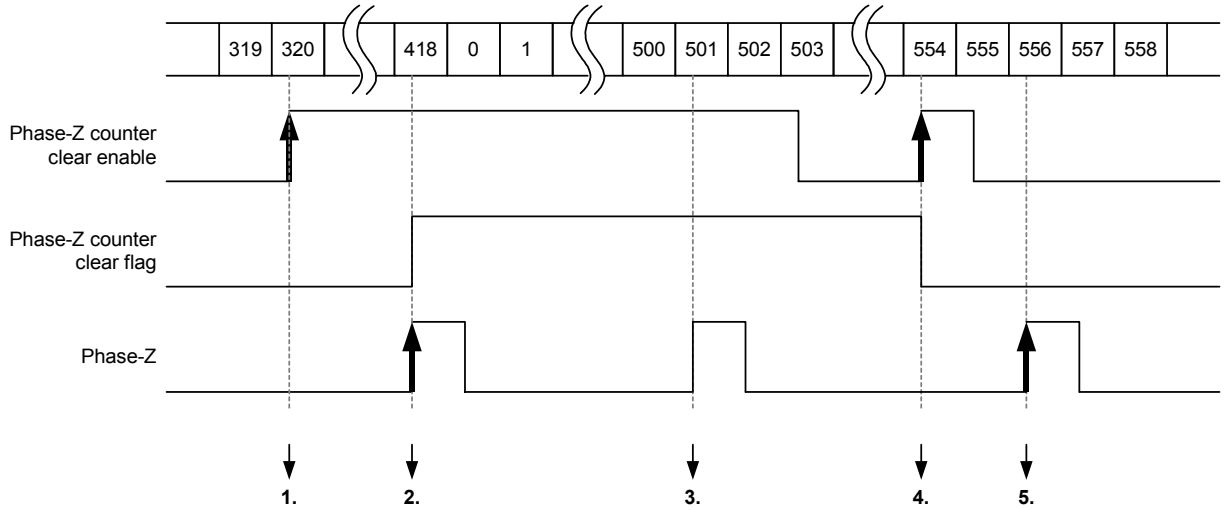
- Counter clear bit
- Phase-Z input



Note When the counter has been cleared with the Phase-Z input, the function is disabled. To enable the function again the enable bit must be cleared and set again.

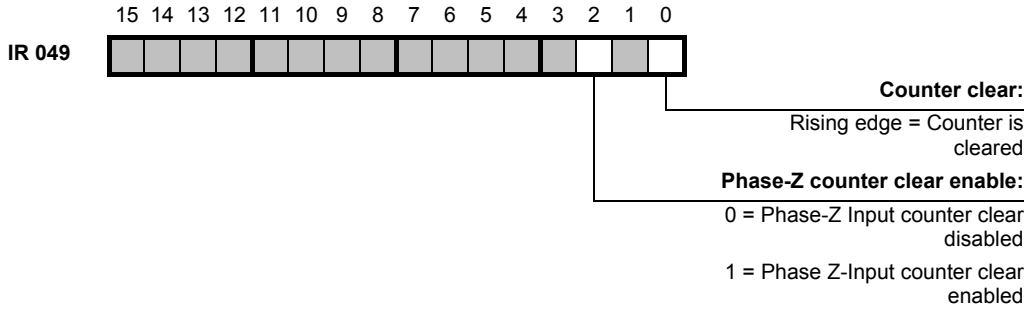
⚠ **Caution** While the Phase-Z counter clear function is enabled, changes to the other bits in IR 049 are prohibited.

The following example shows the behaviour of he Phase-Z clear enable function:



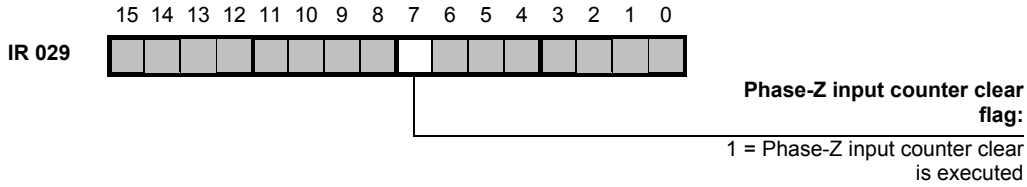
1. The Phase-Z input counter clear function is enabled
2. The Phase-Z input clears the counter.
The Phase-Z input counter clear function is disabled
3. The Phase-Z input does not clear the counter: counter clear flag is set
4. The Phase-Z input counter clear function is enabled again
5. The Phase-Z input does not clear the counter: counter clear enable is not set

The counter clear functions are defined by two bits in IR 049:



⚠ **Caution** While the Phase-Z counter clear function is enabled, changes to the other bits in IR 049 are prohibited.

The Phase-Z counter clear flag signals when the function has been executed:



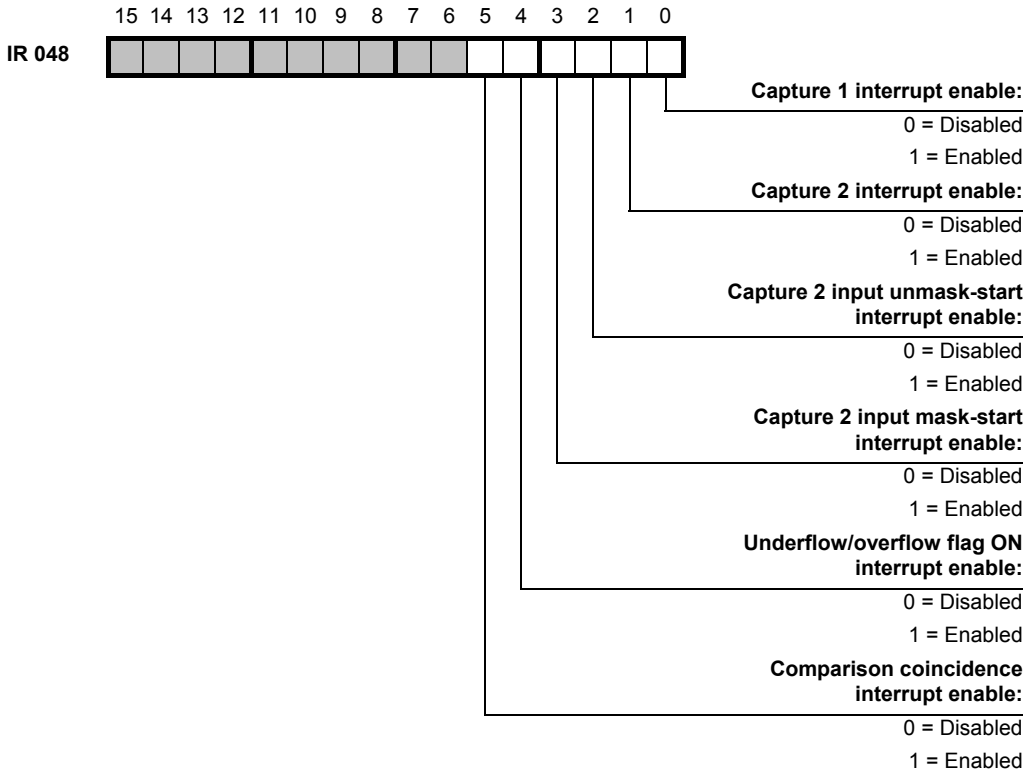
Note The flag is reset when the Phase-Z input counter clear function is enabled again.

8-7 Interrupts

The following sources can be selected to generate an interrupt:

- Capture register 1 event
- Capture register 2 event
- Capture register 2 unmask and mask events
- Under-/Overflow flag
- Comparison

Whether the events listed above generate an interrupt can be configured with enable bits in IR 048. Whenever a bit in this word is cleared (0), the event will not result in an interrupt. Whenever a bit in this word is set (1), the event will result in an interrupt.



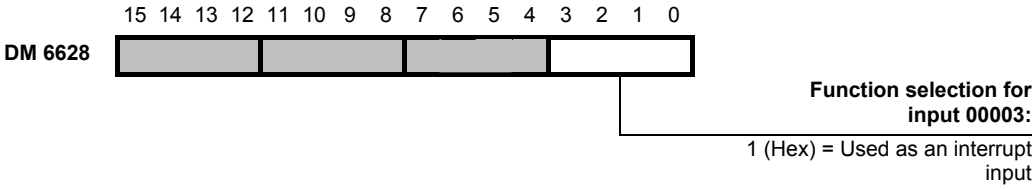
Note When more than one event can generate an interrupt, the exact event cannot be determined in the interrupt program: the status of the corresponding flags are not updated yet.

Note The cause of an interrupt must be cleared before any next event can generate an interrupt. The following events can be cleared by using the appropriate reset bits:

- Overflow (IR 049.04)
- Underflow (IR 049.05)
- Comparison (IR 049.06)

Special case are the Unmask- and Mask-start interrupts: because the Unmask-start interrupt can only be cleared by resetting the masking mechanism, the Mask-start interrupt will not be generated after the Unmask-start interrupt has been generated. Consequence is that enabling both interrupts (Unmask- and Mask-start) is not allowed.

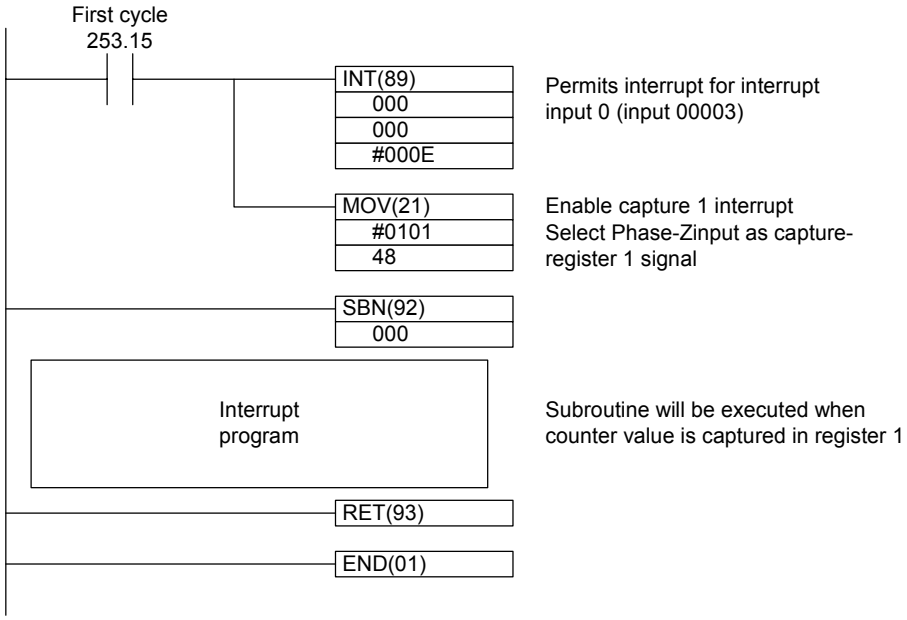
Note To use the interrupt-function of the Counter, enable the interrupt-function of external input 00003 of the PLC. **Do not connect signals to input 00003**.



Response time The interrupt response time is defined as the time required from the occurrence of the interrupt until program execution.

Item	Value
Interrupt response time	0.3 ms

Example The following program enables a subroutine to be executed when a capture of the Counter Value in Capture register 1 occurs.



8-8 Memory Allocation

8-8-1 I/O Allocation IR

<table>
<tr><th>Word(s)</th><th>Bit(s)</th><th>Function</th><th>Read/ write</th></tr>
<tr><td rowspan="10">IR 029</td><td>00</td><td>Capture Register 1 flag:
1: Counter value is captured in Register 1
Note: the flag is active during 1 PLC cycle only</td><td rowspan="10">Read-only</td></tr>
<tr><td>01</td><td>Capture Register 2 flag:
1: Counter value is captured in Register 2
Note: the flag is active during 1 PLC cycle only</td></tr>
<tr><td>02</td><td>Capture Register 2 unmask-start flag:
1: Capture Register 2 unmasked</td></tr>
<tr><td>03</td><td>Capture Register 2 mask-start flag:
1: Capture Register 2 unmask count ended</td></tr>
<tr><td>04</td><td>Counter Overflow:
1: Counter overflow</td></tr>
<tr><td>05</td><td>Counter Underflow:
1: Counter underflow</td></tr>
<tr><td>06</td><td>Comparison coincidence flag
1: Comparison coincidence occurred</td></tr>
<tr><td>07</td><td>Phase-Z input counter clear flag:
1: Phase-Z input counter clear is executed</td></tr>
<tr><td>08 to 15</td><td>Not used</td></tr>
<tr><td rowspan="8">IR 048</td><td>00</td><td>Capture 1 interrupt enable
0: Interrupt disabled
1: Interrupt enabled</td><td rowspan="8">Read/ write</td></tr>
<tr><td>01</td><td>Capture 2 interrupt enable</td></tr>
<tr><td>02</td><td>Capture 2 input unmask-start interrupt enable</td></tr>
<tr><td>03</td><td>Capture 2 input mask-start interrupt enable</td></tr>
<tr><td>04</td><td>Underflow/overflow flag ON interrupt enable</td></tr>
<tr><td>05</td><td>Comparison coincidence interrupt enable</td></tr>
<tr><td>06 to 07</td><td>Phase differential multiplication
<table>
<tr><th>07</th><th>06</th><th>Multiplication</th></tr>
<tr><td>0</td><td>0</td><td>x1</td></tr>
<tr><td>0</td><td>1</td><td>x2</td></tr>
<tr><td>1</td><td>0</td><td>x4</td></tr>
<tr><td>1</td><td>1</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>08 to 10</td><td>Capture register 1 input selection
<table>
<tr><th>10</th><th>09</th><th>08</th><th>Capture input</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>No input</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Phase-Z input</td></tr>
<tr><td>0</td><td>1</td><td>X</td><td>Reserved</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Input 00004</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Input 00005</td></tr>
<tr><td>1</td><td>1</td><td>X</td><td>Reserved</td></tr>
</table>
Note: X = Don’t care</td></tr>
</table>

<table>
<tr><th>Word(s)</th><th>Bit(s)</th><th>Function</th><th>Read/ write</th></tr>
<tr><td>IR 048
continued</td><td>11 to 13</td><td>Capture register 2 input selection
<table>
<tr><th>13</th><th>12</th><th>11</th><th>Capture input</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>No input</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Phase-Z input</td></tr>
<tr><td>0</td><td>1</td><td>X</td><td>Reserved</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Input 00004</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Input 00005</td></tr>
<tr><td>1</td><td>1</td><td>X</td><td>Reserved</td></tr>
</table>
Note: X = Don’t care</td><td rowspan="10">Read/ write</td></tr>
<tr><td>14 to 15</td><td>Encoder interface signal type
<table>
<tr><th>15</th><th>14</th><th>Signal type</th></tr>
<tr><td>0</td><td>X</td><td>Phase Differential</td></tr>
<tr><td>1</td><td>0</td><td>Up & Down</td></tr>
<tr><td>1</td><td>1</td><td>Pulse & Direction</td></tr>
</table>
Note: X = Don’t care</td></tr>
<tr><td>IR 049</td><td>00</td><td>Counter clear
Rising edge: Counter is cleared</td></tr>
<tr><td></td><td>01</td><td>Mask range counter clear
Rising edge: Counter for mask range is cleared</td></tr>
<tr><td></td><td>02</td><td>Phase-Z counter clear enable:
0: Phase-Z input counter clear disabled
1: Phase Z-input counter clear enabled
Note: this function both requires a rising-edge and the bit to be set to be enabled</td></tr>
<tr><td></td><td>03</td><td>Counter Disable
0: Counter is enabled
1: Counter is disabled</td></tr>
<tr><td></td><td>04</td><td>Overflow Reset
Rising edge: Overflow is cleared</td></tr>
<tr><td></td><td>05</td><td>Underflow Reset
Rising edge: Underflow is cleared</td></tr>
<tr><td></td><td>06</td><td>Comparison coincidence clear
Rising edge: Comparison coincidence flag is cleared</td></tr>
<tr><td></td><td>07 to 15</td><td>Reserved</td></tr>
</table>

8-8-2 I/O-Allocation DM

Word(s)	Function		Read/ write
DM 1986	Counter value	15-0(LSB) bits	Read-only
DM 1987		31(MSB)-16bits	
DM 1988	Capture register 1	15-0(LSB) bits	
DM 1989		31(MSB)-16bits	
DM 1990	Capture register 2	15-0(LSB) bits	
DM 1991		31(MSB)-16bits	
DM 1992	Comparison data	15-0(LSB) bits	Read/ write
DM 1993		31(MSB)-16bits	
DM 1994	Full-count register	15-0(LSB) bits	
DM 1995		31(MSB)-16bits	
DM 1996	Unmask count	15-0(LSB) bits	
DM 1997		31(MSB)-16bits	
DM 1998	Mask count	15-0(LSB) bits	
DM 1999		31(MSB)-16bits	

Appendix A
Instructions

The 3G3RV-P10ST supports 119 basic and special instructions.

■ Ladder Diagram Instructions

Name	Mnemonic	Variations
LOAD	LD	---
LOAD NOT	LD NOT	---
AND	AND	---
AND NOT	AND NOT	---
OR	OR	---
OR NOT	OR NOT	---
AND LOAD	AND LD	---
OR LOAD	OR LD	---

■ Bit Control Instructions

Name	Mnemonic	Variations
OUTPUT	OUT	---
OUTPUT NOT	OUT NOT	---
SET	SET	---
RESET	RSET	---
KEEP	KEEP(11)	---
DIFFERENTIATE UP	DIFU(13)	---
DIFFERENTIATE DOWN	DIFD(14)	---

■ Sequence Control Instructions

Name	Mnemonic	Variations
NO OPERATION	NOP(00)	---
END	END(01)	---
INTERLOCK	IL(02)	---
INTERLOCK CLEAR	ILC(03)	---
JUMP	JMP(04)	---
JUMP END	JME(05)	---

■ Timer and Counter Instructions

Name	Mnemonic	Variations
TIMER	TIM	---
COUNTER	CNT	---
REVERSIBLE COUNTER	CNTR(12)	---
HIGH-SPEED TIMER	TIMH(15)	---
ONE-MS TIMER	TMHH(—[1])	---
LONG TIMER	TIML(—[1])	---

■ Comparison Instructions

Name	Mnemonic	Variations
COMPARE	CMP(20)	---
TABLE COMPARE	TCMP(85)	@
DOUBLE COMPARE	CMPL(60)[1]	---
BLOCK COMPARE	BCMP(68)[1]	@
AREA RANGE COMPARE	ZCP(—[1])	---
DOUBLE AREA RANGE COMPARE	ZCPL(—[1])	---

■ Data Movement Instructions

Name	Mnemonic	Variations
MOVE	MOV(21)	@
MOVE NOT	MVN(22)	@
BLOCK TRANSFER	XFER(70)	@
BLOCK SET	BSET(71)	@
DATA EXCHANGE	XCHG(73)	@
SINGLE WORD DISTRIBUTE	DIST(80)	@
DATA COLLECT	COLL(81)	@
MOVE BIT	MOVB(82)	@
MOVE DIGIT	MOVD(83)	@

■ Shift Instructions

Name	Mnemonic	Variations
SHIFT REGISTER	SFT(10)	---
WORD SHIFT	WSFT(16)	@
ARITHMETIC SHIFT LEFT	ASL(25)	@
ARITHMETIC SHIFT RIGHT	ASR(26)	@
ROTATE LEFT	ROL(27)	@
ROTATE RIGHT	ROR(28)	@
ONE DIGIT SHIFT LEFT	SLD(74)	@
ONE DIGIT SHIFT RIGHT	SRD(75)	@
REVERSIBLE SHIFT REGISTER	SFTR(84)	@
ASYNCHRONOUS SHIFT REGISTER	ASFT(17)[1]	@

■ Increment/Decrement Instructions

Name	Mnemonic	Variations
INCREMENT	INC(38)	@
DECREMENT	DEC(39)	@

■ Calculation Instructions

Name	Mnemonic	Variations
BCD ADD	ADD(30)	@
BCD SUBTRACT	SUB(31)	@
BCD MULTIPLY	MUL(32)	@
BCD DIVIDE	DIV(33)	@
BINARY ADD	ADB(50)	@
BINARY SUBTRACT	SBB(51)	@
BINARY MULTIPLY	MLB(52)	@
BINARY DIVIDE	DVB(53)	@
DOUBLE BCD ADD	ADDL(54)	@
DOUBLE BCD SUBTRACT	SUBL(55)	@
DOUBLE BCD MULTIPLY	MULL(56)	@
DOUBLE BCD DIVIDE	DIVL(57)	@

Note 1. Expansion instructions with default function codes

■ Conversion Instructions

Name	Mnemonic	Variations
BCD-TO-BINARY	BIN(23)	@
BINARY-TO-BCD	BCD(24)	@
DOUBLE BCD-TO-DOUBLE BINARY	BINL(58)	@
DOUBLE BINARY-TO-DOUBLE BCD	BCDL(59)	@
DATA DECODER	MLPX(76)	@
DATA ENCODER	DMPX(77)	@
ASCII CONVERT	ASC(86)	@
ASCII-TO-HEXADECIMAL	HEX(—[1])	@
2'S COMPLEMENT	NEG(—[1])	@
HOURS-TO-SECONDS	SEC(—[1])	@
SECONDS-TO-HOURS	HMS(—[1])	@

■ Table Data Manipulation Instructions

Name	Mnemonic	Variations
FRAME CHECKSUM	FCS(—[1])	@
SUM	SUM(—[1])	@
DATA SEARCH	SRCH(—[1])	@
FIND MAXIMUM	MAX(—[1])	@
FIND MINIMUM	MIN(—[1])	@

■ Data Control Instructions

Name	Mnemonic	Variations
SCALING	SCL(66)[1]	@
SCALING 2	SCL2(—[1])	@
SCALING 3	SCL3(—[1])	@
PID CONTROL	PID(—[1])	---
AVERAGE VALUE	AVG(—[1])	---

■ Logic Instructions

Name	Mnemonic	Variations
COMPLEMENT	COM(29)	@
LOGICAL AND	ANDW(34)	@
LOGICAL OR	ORW(35)	@
EXCLUSIVE OR	XORW(36)	@
EXCLUSIVE NOR	XNRW(37)	@

■ Special Calculation Instructions

Name	Mnemonic	Variations
BIT COUNTER	BCNT(67)[1]	@

■ Subroutine Instructions

Name	Mnemonic	Variations
SUBROUTINE CALL	SBS(91)	@
SUBROUTINE ENTRY	SBN(92)	---
SUBROUTINE RETURN	RET(93)	---
MACRO	MCRO(99)	@

■ Interrupt Control Instructions

Name	Mnemonic	Variations
INTERRUPT CONTROL	STIM(69)[1]	@
INTERVAL TIMER	INT(89)[1]	@

■ Pulse Control Instructions

Name	Mnemonic	Variations
MODE CONTROL	INI(61)[1]	@
HIGH-SPEED COUNTER PV READ	PRV(62)[1]	@
REGISTER COMPARISON TABLE	CTBL(63)[1]	@

■ Pulse Output Control Instructions

Name	Mnemonic	Variations
SPEED OUTPUT	SPED(64)[1]	@
SET PULSES	PULS(65)[1]	@
PULSE W/ VARIABLE DUTY	PWM(—[1])	@
RATIO		
ACCELERATION CONTROL	ACC(—[1])	@
SYNCHRONIZED PULSE	SYNC(—[1])	@
CONTROL		

■ I/O Unit Instructions

Name	Mnemonic	Variations
7-SEGMENT DECODER	SDEC(78)	@
I/O REFRESH	IORF(97)	@

■ Communications Instructions

Name	Mnemonic	Variations
RECEIVE	RXD(47)[1]	@
TRANSMIT	TXD(48)[1]	@
CHANGE RS-232C SETUP	STUP(—[1])	@

■ Step Instructions

Name	Mnemonic	Variations
STEP DEFINE	STEP(08)	---
STEP START	SNXT(09)	---

■ User Error Instructions

Name	Mnemonic	Variations
FAILURE ALARM AND RESET	FAL(06)	@
SEVERE FAILURE ALARM	FALS(07)	---

■ Display Instructions

Name	Mnemonic	Variations
MESSAGE DISPLAY	MSG(46)	@

■ Carry Flag Instructions

Name	Mnemonic	Variations
SET CARRY	STC(40)	@
CLEAR CARRY	CLC(41)	@

Note 1. Expansion instructions with default function codes.

Appendix B
Example programs

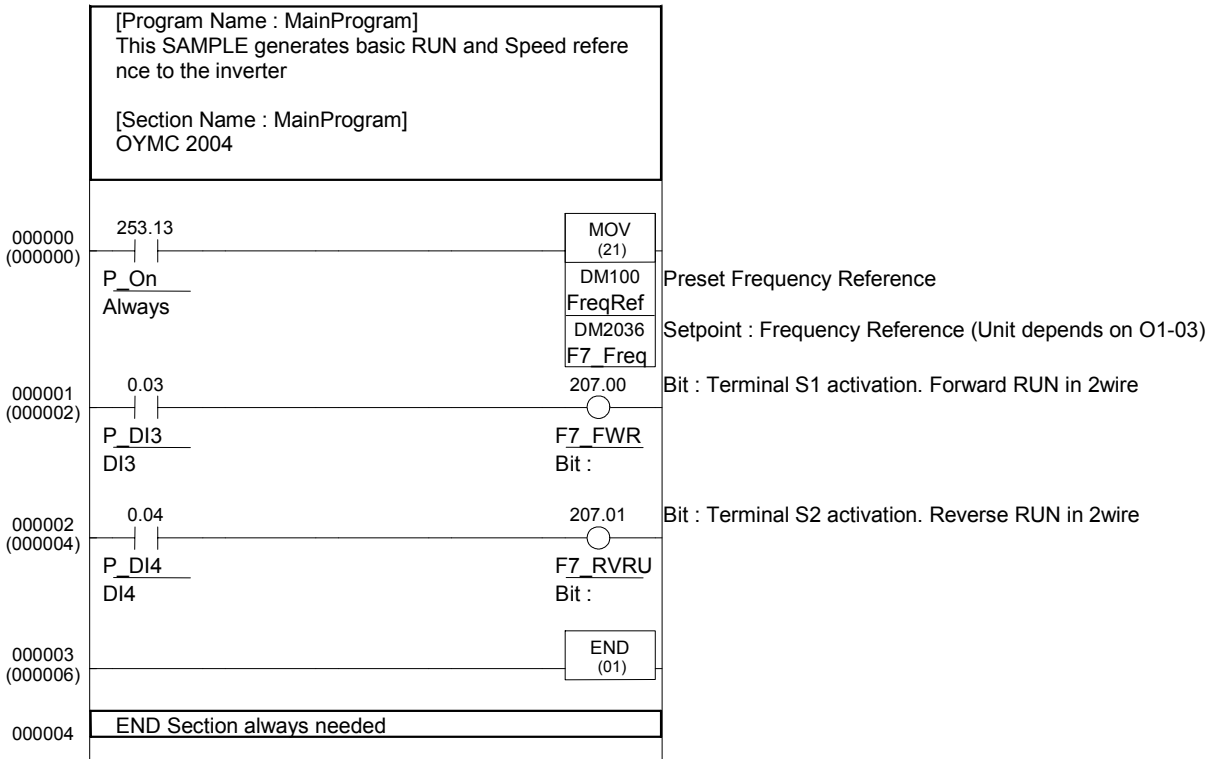
B-1 Basic RUN template program

The PLC option board for F7 (E7, L7 and G7) Inverters provides a very simple interface and direct way of controlling the RUN and speed reference of the inverter.

For L7 the selected sequencing mode for this sample to work has to be F7 compatible (D1-18=0). If not special RUN sequence rules are applied (with D1-18=1 or 2, the inverter always waits for both RUN signal and a digital signal selecting speed reference, Nominal, Levelling, etc...). This can be simulated also by activating the corresponding input together.

Parameter	Type	Description	Default Value
DM2036	WORD R/W Decimal	F7_Freq_Ref_Set : Speed reference in decimal value. Units according to n035. By default 0.01Hz (n035=0)	0
207.00	BIT R/W	F7_FWRUN_S1 : Generates Forward Run Command (1)	0
207.01	BIT R/W	F7_RVRUN_S2 : Generates Reverse Run Command (1)	0
209.00	BIT R/W	F7_NetRef_Set : 0=Reference from PLC board (DM2036)	0
209.01	BIT R/W	F7_NetCtrl_Set : 1=Run signals from PLC board (207.00 and 207.01)	0

B-1-1 Ladder



B-1-2 Mnemonics

```
LD P_On
MOV(21) FreqRefPreset F7_Freq_Ref_Set
LD P_DI3
OUT F7_FWRUN_S1
LD P_DI4
OUT F7_RVRUN_S2
END(01)
```

B-2 Basic Read Parameter template program

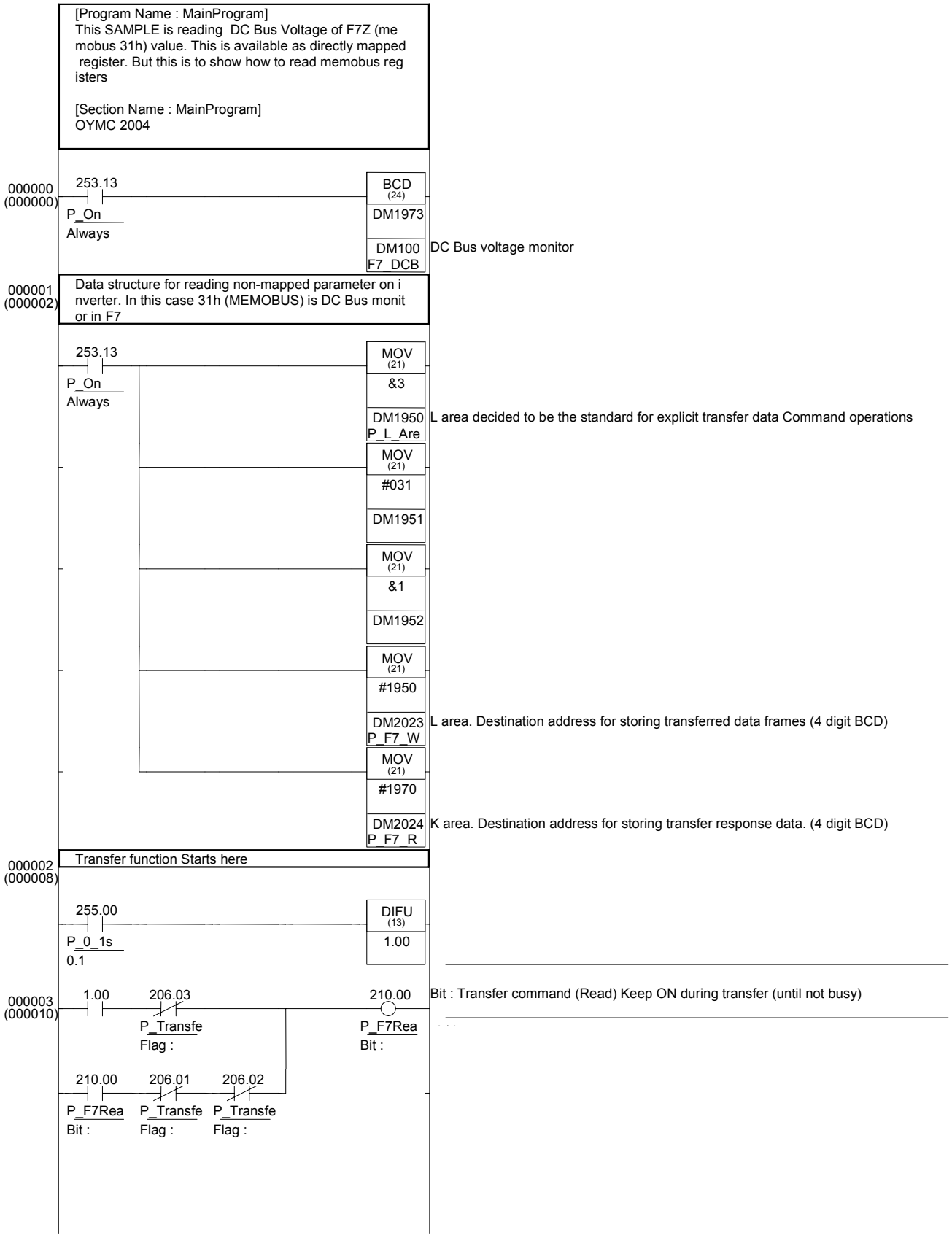
This SAMPLE is reading DC Bus Voltage of F7 (E7, L7 or G7) (31h) value. This monitor is already mapped in the PLC as DM2032, but this sample serves to show how to read MEMOBUS registers.

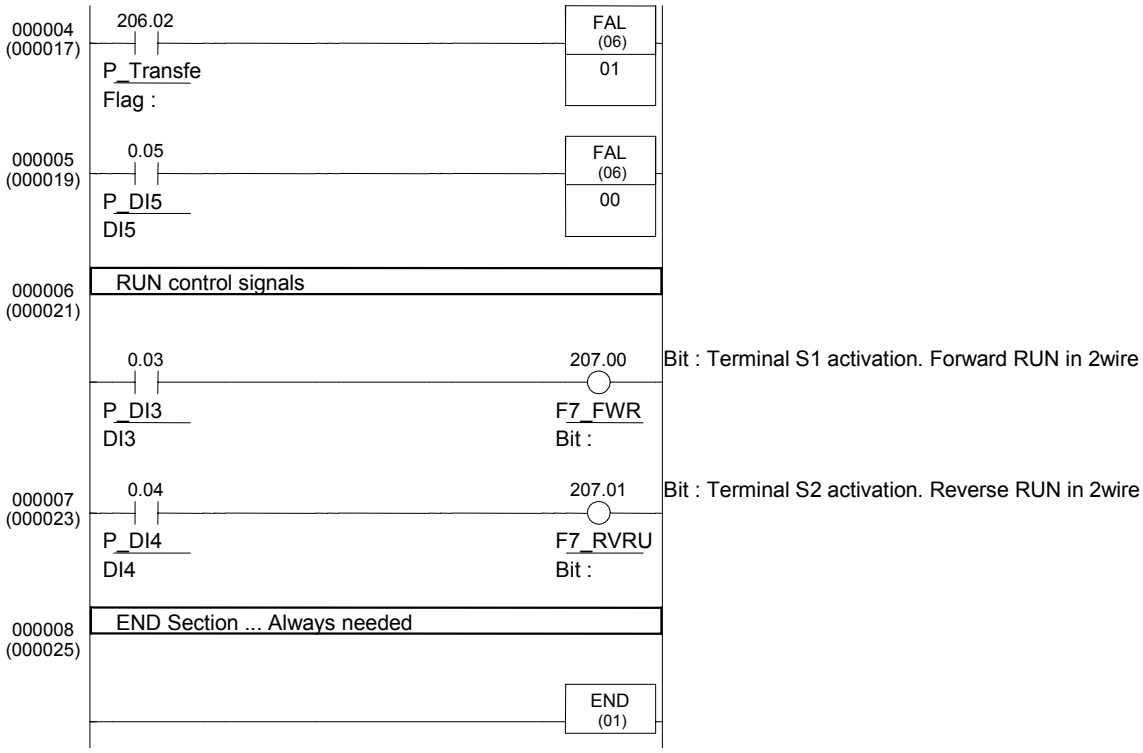
It writes in DM100 as BCD. Compare the value with DM2032…. Although the selection of the transfer zones is free for the user, it is recommended to follow the recommendations (DM1950 and DM1970..)

With L7, D1-18=0 to have the same RUN behaviour as F7.

Parameter	Type	Description	Recom-mended
210.00	BIT (R/W)	Transfer (Read) (ON: Begin Reading; turns OFF when transfer is completed.)	0
210.01	BIT (R/W)	Transfer (Write) (ON: Begin writing; turns OFF when transfer is completed.)	0
206.00	BIT (R/W)	Inverter Ready (error detected by mutual diagnosis) (ON: Normal; OFF: Error)	0
206.01	BIT (R/W)	Transfer completion bit (ON: Transfer completed; turns OFF when TRANSFER command turns OFF.)	0
206.02	BIT (R/W)	Transfer error (ON: Error; OFF: Normal)	0
206.03	BIT (R/W)	Transfer busy (ON: Busy; OFF: Ready for transfer)	
DM2023	WORD (R/W) BCD	Destination address for storing transferred data (4 digits BCD): L. We recommend using DM1950	1950
DM2024	WORD (R/W) BCD	Destination address for storing transfer response data (4 digits BCD): K . We recommend using DM1970	1970

B-2-1 Ladder


[Program Name : MainProgram]
This SAMPLE is reading DC Bus Voltage of F7Z (me mobus 31h) value. This is available as directly mapped register. But this is to show how to read memobus reg isters
[Section Name : MainProgram]
OYMC 2004
000000
(000000)
253.13
P_On
Always
BCD
(24)
DM1973
DM100
F7_DCB
DC Bus voltage monitor
000001
(000002)
Data structure for reading non-mapped parameter on i nverter. In this case 31h (MEMOBUS) is DC Bus monit or in F7
253.13
P_On
Always
MOV
(21)
&3
DM1950
P_L_Are
L area decided to be the standard for explicit transfer data Command operations
MOV
(21)
#031
DM1951
MOV
(21)
&1
DM1952
MOV
(21)
#1950
DM2023
P_F7_W
L area. Destination address for storing transferred data frames (4 digit BCD)
MOV
(21)
#1970
DM2024
P_F7_R
K area. Destination address for storing transfer response data. (4 digit BCD)
000002
(000008)
Transfer function Starts here
255.00
P_0_1s
0.1
DIFU
(13)
1.00
000003
(000010)
1.00
206.03
P_Transfe
Flag :
210.00
P_F7Rea
Bit :
Bit : Transfer command (Read) Keep ON during transfer (until not busy)
210.00
P_F7Rea
Bit :
206.01
P_Transfe
Flag :
206.02
P_Transfe
Flag :



B-2-2 Mnemonics

```
LD P_On
BCD(24) DM1973 F7_DCBusV_Monitor
'  Data structure for reading non-mapped parameter on inverter. In this case 31h (MEMOBUS) is
DC Bus monitor in F7
LD P_On
MOV(21) &3 P_L_Area
MOV(21) #031 DM1951
MOV(21) &1 DM1952
MOV(21) #1950 P_F7_Write_Area
MOV(21) #1970 P_F7_Read_Area
'  Transfer function Starts here
LD P_0_1s
DIFU(13) 1.00
LD 1.00
ANDNOT P_Transfer_Busy
LD P_F7Read
ANDNOT P_Transfer_Complete
ANDNOT P_Transfer_Error
ORLD
OUT P_F7Read
LD P_Transfer_Error
FAL(06) 01
LD P_DI5
FAL(06) 00
'  RUN control signals
LD P_DI3
OUT F7_FWRUN_S1
LD P_DI4
OUT F7_RVRUN_S2
'  END Section ... Always needed
END(01)
```

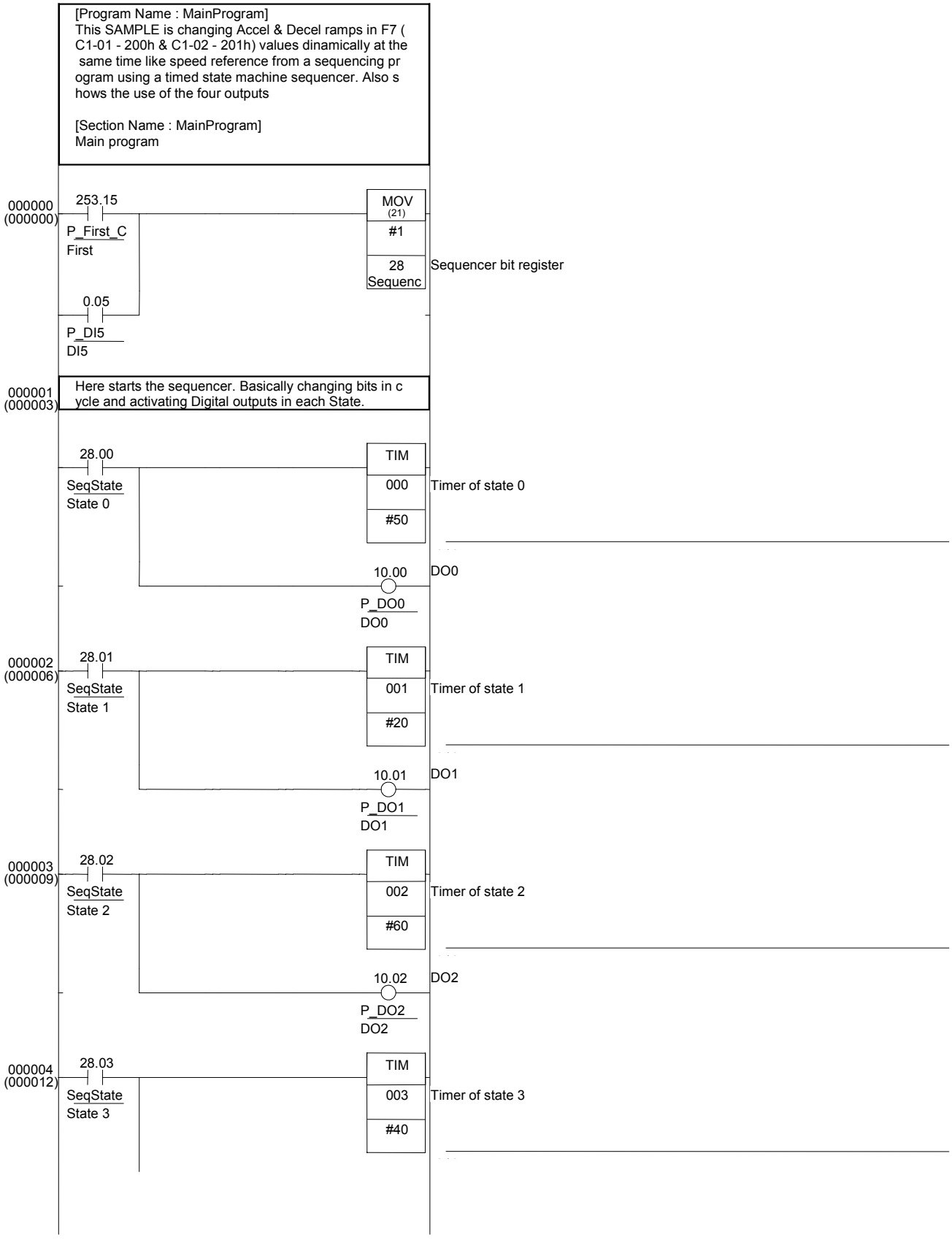
B-3 Basic Write Parameter template program

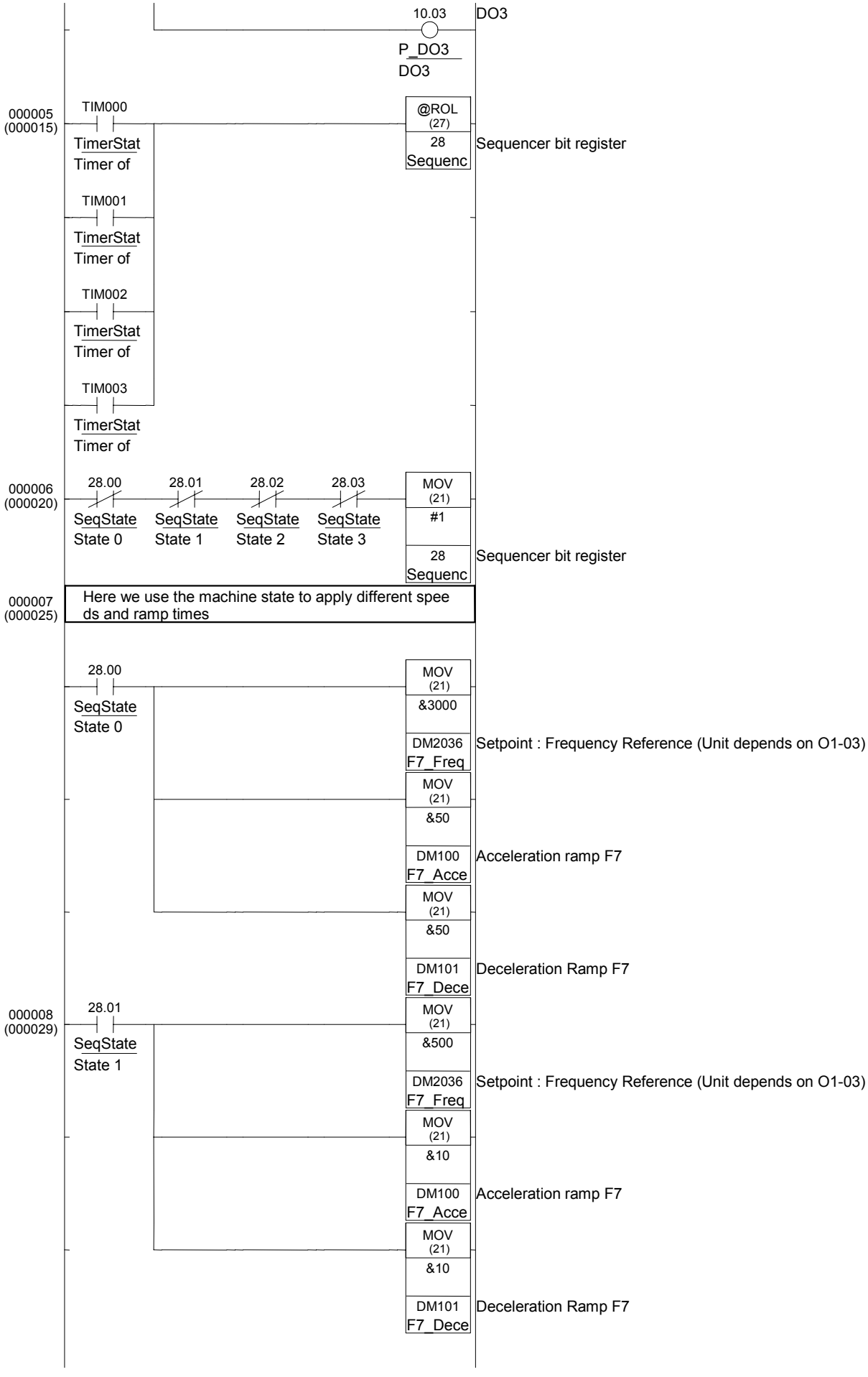
The PLC option board for F7 (E7, L7 and G7 as well) inverters provides many directly mapped parameters. But if some non-mapped parameter is needed to be modified, then the transfer functionality is required. The same rules like operator terminal action are applied. Some parameters are not possible to change During Run, etc..

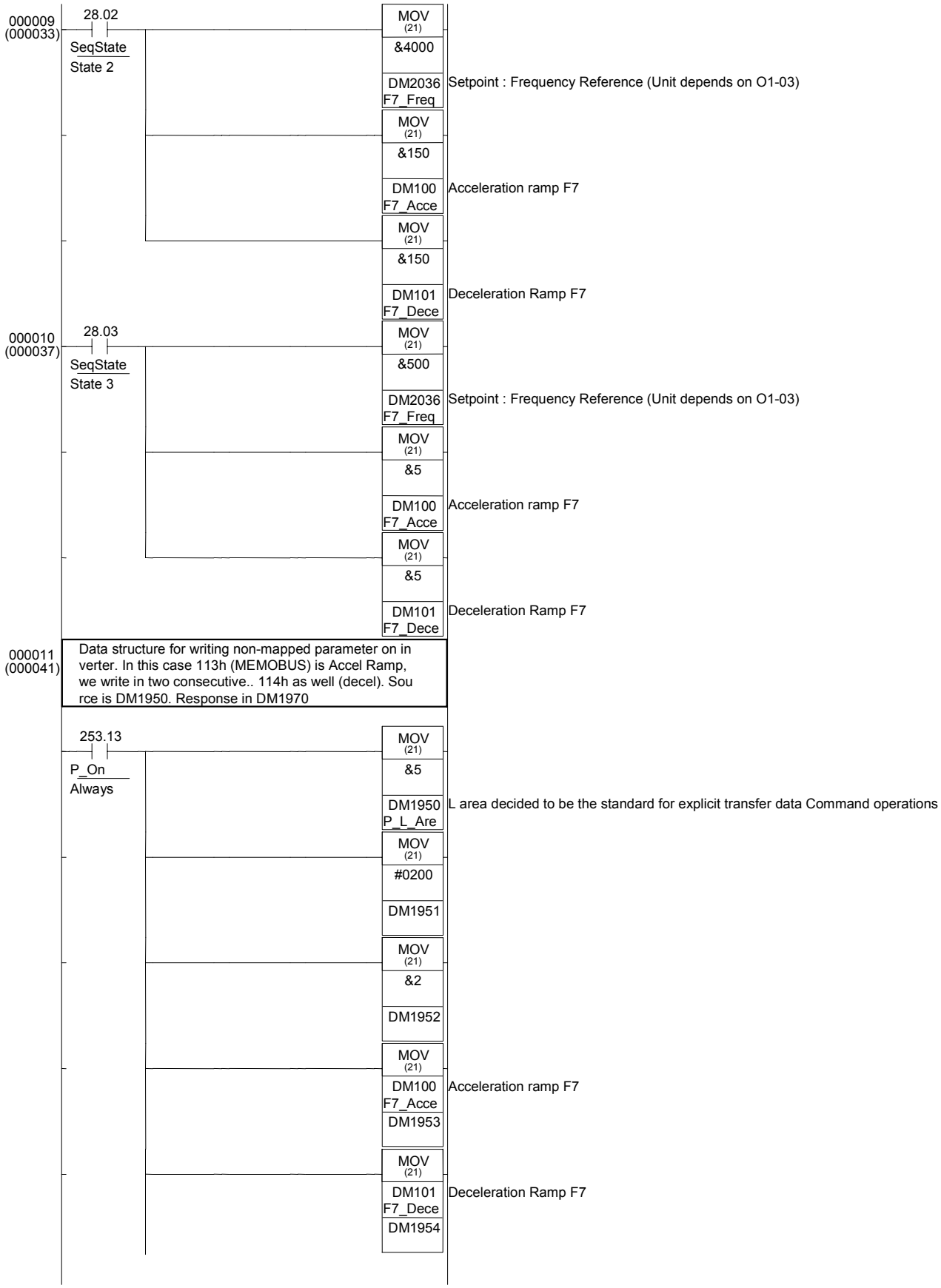
This SAMPLE is changing ramp (C1-01 – MEMOBUS register 200h & C1-02 - 201h) values dynamically at the same time like speed from a sequencing program using a timed state machine sequencer. Also shows the use of the 4 PLC outputs. As the two registers are consecutive, the writing is done in a single shot command.

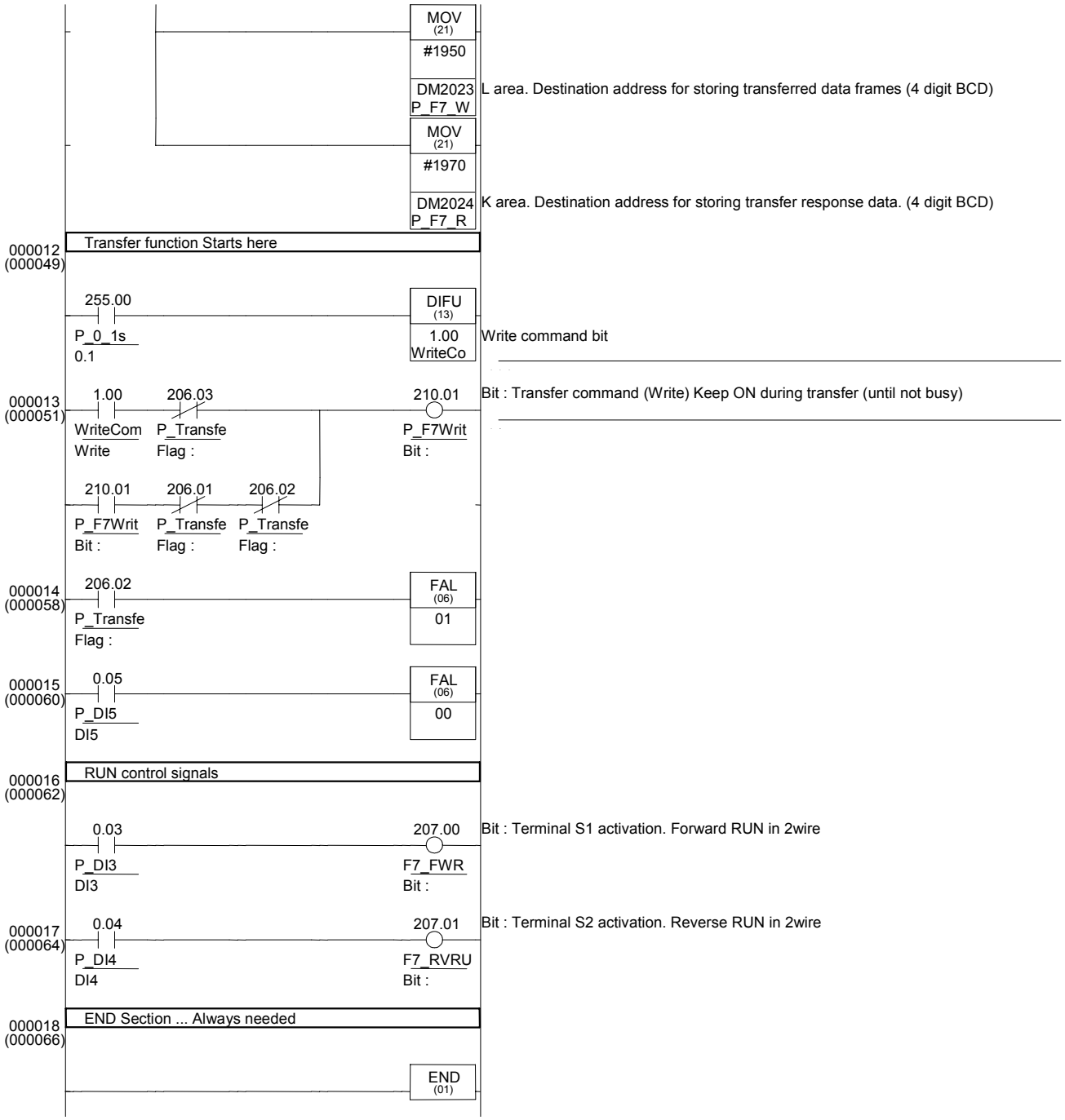
With L7, D1-18=0 to have the same RUN behaviour as F7.

B-3-1 Ladder




10.03
DO3
P_DO3
DO3
000005
(000015)
TIM000
TimerStat
Timer of
@ROL
(27)
28
Sequenc
Sequencer bit register
TIM001
TimerStat
Timer of
TIM002
TimerStat
Timer of
TIM003
TimerStat
Timer of
000006
(000020)
28.00
SeqState
State 0
28.01
SeqState
State 1
28.02
SeqState
State 2
28.03
SeqState
State 3
MOV
(21)
#1
28
Sequenc
Sequencer bit register
000007
(000025)
Here we use the machine state to apply different spee
ds and ramp times
28.00
SeqState
State 0
MOV
(21)
&3000
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
MOV
(21)
&50
DM100
F7_Acce
Acceleration ramp F7
MOV
(21)
&50
DM101
F7_Dece
Deceleration Ramp F7
000008
(000029)
28.01
SeqState
State 1
MOV
(21)
&500
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
MOV
(21)
&10
DM100
F7_Acce
Acceleration ramp F7
MOV
(21)
&10
DM101
F7_Dece
Deceleration Ramp F7


000009
(000033)
28.02
SeqState
State 2
MOV (21)
&4000
DM2036 F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
MOV (21)
&150
DM100 F7_Acce
Acceleration ramp F7
MOV (21)
&150
DM101 F7_Dece
Deceleration Ramp F7
000010
(000037)
28.03
SeqState
State 3
MOV (21)
&500
DM2036 F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
MOV (21)
&5
DM100 F7_Acce
Acceleration ramp F7
MOV (21)
&5
DM101 F7_Dece
Deceleration Ramp F7
000011
(000041)
Data structure for writing non-mapped parameter on in verter. In this case 113h (MEMOBUS) is Accel Ramp, we write in two consecutive.. 114h as well (decel). Sou rce is DM1950. Response in DM1970
253.13
P_On
Always
MOV (21)
&5
DM1950 P_L_Are
L area decided to be the standard for explicit transfer data Command operations
MOV (21)
#0200
DM1951
MOV (21)
&2
DM1952
MOV (21)
DM100 F7_Acce
DM1953
Acceleration ramp F7
MOV (21)
DM101 F7_Dece
DM1954
Deceleration Ramp F7


MOV (21)
#1950
DM2023 P_F7_W
L area. Destination address for storing transferred data frames (4 digit BCD)
MOV (21)
#1970
DM2024 P_F7_R
K area. Destination address for storing transfer response data. (4 digit BCD)
000012 (000049)
Transfer function Starts here
255.00 P_0_1s 0.1
DIFU (13)
1.00 WriteCo
Write command bit
000013 (000051)
1.00 WriteCom Write
206.03 P_Transfe Flag :
210.01 P_F7Writ Bit :
Bit : Transfer command (Write) Keep ON during transfer (until not busy)
210.01 P_F7Writ Bit :
206.01 P_Transfe Flag :
206.02 P_Transfe Flag :
000014 (000058)
206.02 P_Transfe Flag :
FAL (06)
01
000015 (000060)
0.05 P_DI5 DI5
FAL (06)
00
000016 (000062)
RUN control signals
0.03 P_DI3 DI3
207.00 F7_FWR Bit :
Bit : Terminal S1 activation. Forward RUN in 2wire
000017 (000064)
0.04 P_DI4 DI4
207.01 F7_RVRU Bit :
Bit : Terminal S2 activation. Reverse RUN in 2wire
000018 (000066)
END Section ... Always needed
END (01)

B-3-2 Mnemonics

```
LD P_First_Cycle
OR P_DI5
MOV(21) #1 SequencerReg
'  Here starts the sequencer. Basically changing bits in cycle and activating Digital outputs
in each State.
LD SeqState0
TIM 000 #50
OUT P_DO0
LD SeqState1
TIM 001 #20
OUT P_DO1
LD SeqState2
TIM 002 #60
OUT P_DO2
LD SeqState3
TIM 003 #40
OUT P_DO3
LD TimerState0
OR TimerState1
OR TimerState2
OR TimerState3
@ROL(27) SequencerReg
LDNOT SeqState0
ANDNOT SeqState1
ANDNOT SeqState2
ANDNOT SeqState3
MOV(21) #1 SequencerReg
'  Here we use the machine state to apply different speeds and ramp times
LD SeqState0
MOV(21) &3000 F7_Freq_Ref_Set
MOV(21) &50 F7_Accel_Ramp
MOV(21) &50 F7_Decel_Ramp
LD SeqState1
MOV(21) &500 F7_Freq_Ref_Set
MOV(21) &10 F7_Accel_Ramp
MOV(21) &10 F7_Decel_Ramp
LD SeqState2
MOV(21) &4000 F7_Freq_Ref_Set
MOV(21) &150 F7_Accel_Ramp
MOV(21) &150 F7_Decel_Ramp
LD SeqState3
MOV(21) &500 F7_Freq_Ref_Set
MOV(21) &5 F7_Accel_Ramp
MOV(21) &5 F7_Decel_Ramp
'  Data structure for writing non-mapped parameter on inverter. In this case 113h (MEMOBUS) is
Accel Ramp, we write in two consecutive.. 114h as well (decel). Source is DM1950. Response in
DM1970
LD P_On
MOV(21) &5 P_L_Area
MOV(21) #0200 DM1951
MOV(21) &2 DM1952
MOV(21) F7_Accel_Ramp DM1953
MOV(21) F7_Decel_Ramp DM1954
MOV(21) #1950 P_F7_Write_Area
MOV(21) #1970 P_F7_Read_Area
'  Transfer function Starts here
LD P_0_1s
DIFU(13) WriteCommand
LD WriteCommand
ANDNOT P_Transfer_Busy
LD P_F7Write
ANDNOT P_Transfer_Complete
ANDNOT P_Transfer_Error
ORLD
OUT P_F7Write
LD P_Transfer_Error
FAL(06) 01
LD P_DI5
FAL(06) 00
'  RUN control signals
LD P_DI3
OUT F7_FWRUN_S1
LD P_DI4
OUT F7_RVRUN_S2
'  END Section ... Always needed
END(01)
```

B-4 F7-PLC SAMPLE : Basic Positioning template program using PLC High Speed Inputs for LowFreq Encoder

The PLC option board for F7Z inverters provides the needed hardware to perform a basic position control software. We can read an encoder with A and B phase signals, digital inputs and have complete control on the inverter speed and Run commands. We have additional I/O and fully programmable PLC. That's all needed for a position controller application.

With F7Z we have three options to perform positioning :

- **AVAILABLE SAMPLE**: The example provided below uses the standard PLC High speed inputs for low freq encoder counting (inputs 0-1). PLC performs the position control loop. 24Vdc encoder can be used up to 5KHz.. This encoder is typically external to the motor placed in some position in the machine. This program can work in Open loop or Closed loop, providing best performance with any load in closed loop.. In open loop, high inertia loads are difficult to handle with high dynamics

- **UNDER DEVELOPMENT**: The new 50KHz Encoder Inputs Sample program for positioning are under development. PLC performs the position control loop. TTL line driver encoder can be used up to 50KHz. In some cases, the same encoder used for closed loop vector control can be used for the positioning loop. This is the advantage of using this high speed counter input... The disadvantage is that the numbers to be handled are bigger (as counting is 10 times faster), and more than two PLC registers are needed to store position, and 4 register calculations are required.

- **UNDER DEVELOPMENT**: Positioning directly controlled by the inverter encoder input is also under development, this inverter encoder input can not be handled directly by the PLC, due to hardware limitations. Special firmware for the F7Z is required to perform positioning within the inverter, but with the advantage that the PLC doesn't need to perform the control loops, freeing up the PLC from this task and providing a more powerful positioning control loop synchronized with the inverter cycle. The PLC will coordinate the position setpoints and machine sequence in this case...

In the provided sample, the control loop is performed by the ladder program. The selected control loop performs a very simple P controller on the position error between demanded and real positions.. Then it limits and applies a frequency reference proportional to it. With this setup, without profile generator (acceleration, deceleration generated by position reference calculations), we have a compact position controller software, that will solve a lot of simple point to point applications.

B-4-1 METHOD

- We apply directly the position difference as speed reference , we have programmed some acceleration on the inverter (so it will ramp up at that defined rate). The inverter has zero deceleration, so when the position is reaching the point automatically the speed is reduced gradually, generating some non-linear ramp, but stopping in the correct position.
- As the PLC can not handle big negative numbers we have to apply an offset position and work around an intermediate point, scaling for the user.

B-4-2 FEATURES

- Easy to use
- Continuous loop
- Scaled setpoint by N1/N2 factor.
- 2 InPosition windows. The second one can be defined bigger for faster sequence control.
- Variable P Gain
- Position_Reset available
- Home(origin) search sequence, with fast forward and slow backwards seek. Definable speeds
- Home(origin) timeout control

B-4-3 LIMITATIONS

- In Open Loop control method of F7Z, with only P type of controller, inertial loads might not be well handled by the software, leading to oscillation. Lowering P gain can help, but this lowers dynamics as well. It is preferred some kind of frictional load. Most applications that use a high gear-ratio gear-motor will be mostly controlled. To control inertial loads a more sophisticated control loop should be programmed. Using a free motor can lead to instability. Closed Loop control method is recommended for this type of loads, but the drawback is that the same encoder can rarely be used for the inverter feedback and the positioning at the same type due to frequency limit of 5KHz in the counter inputs of the PLC. For reference, a 1500rpm motor could use maximum 200ppr encoder (enough for some applications anyway, but the positioning register counter might quickly wrap around as it will count 800 counts each revolution)
- Deceleration profile will be exponential due to the method of using the position difference to generate speed reference.
- We are limited to two word position references. So 80000000 quadrature pulses approx.
- The values allowed for the fractional factor limit the reference position range. Scaling intermediate results can only be two word values. The bigger the factor, the shortest the position reference allowed. It is recommended to use values from 1 to 10 in N1 and N2.
- The positioner doesn't have the real concept of following error as the program does not perform a real positioning profile. We only have the "demanded-real position" error.
- Position counter does not handle wrap around of the counter

B-4-4 RECOMMENDED USE

- This software sample is intended to be used in Point to Point applications were absolute positioning is required. Relative positioning if Counter reset is allowed in each cycle.

B-4-5 INVERTER/PLC SETUP

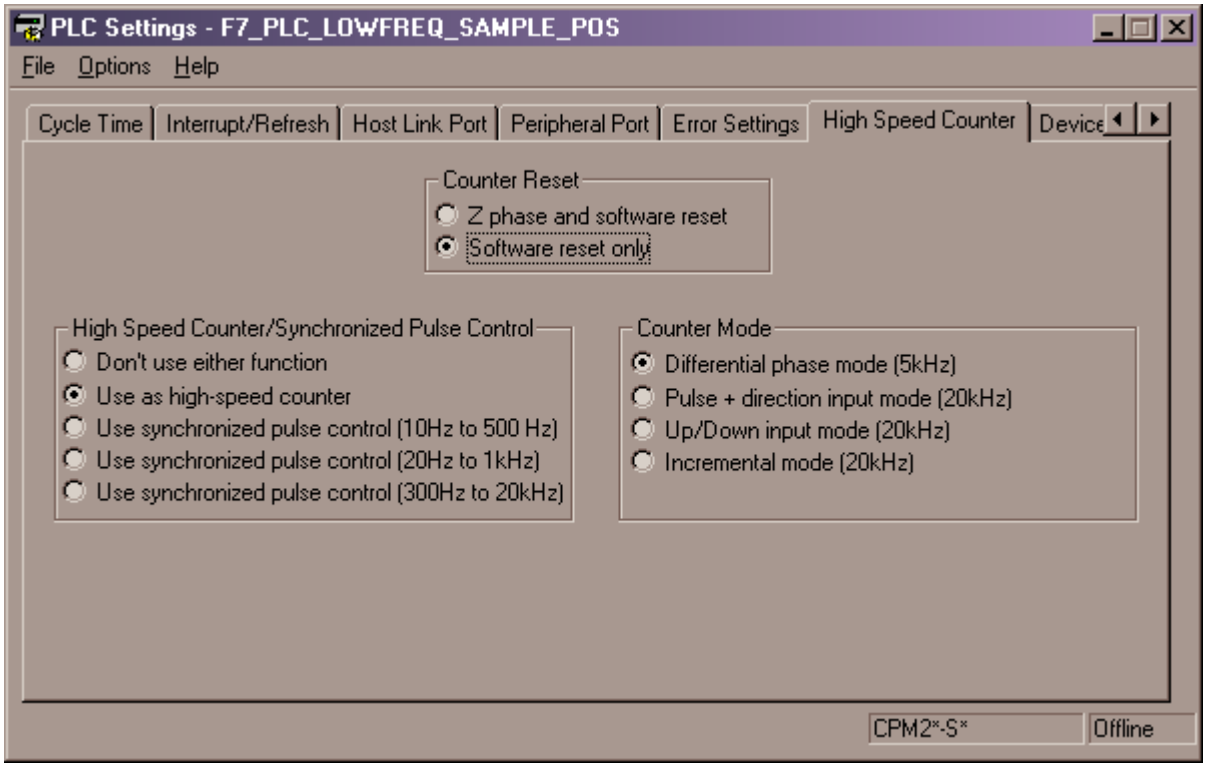
We need some specific settings in the inverter for a correct positioner work :

- We will use two sets of ramps… one is for the positioning with acceleration defined and deceleration set to zero…
- C1-01=1 sec C1-02=0 sec for position control (C1-02 must be always zero).
- Also s-ramps need to be disabled : C2-01=0s, C2-02=0s, C2-03=0s and C2-04=0s
- The other will be used in speed control mode, where we require both acceleration and deceleration to be active… C1-03=2 sec C1-04=2 sec for speed control or any other desired value.
- H1-03=7 (accel/deccel Time selection by S5 or internally controlled by PLC) to allow the program to do the changeover automatically. The PLC will simulate that input by 207.04 control bit
- It is recommended a modified VF curve (only in open loop control methods, VF of OLV) for better response in the lower frequency range … Typically values like following are good initial values : E1-09=0.1Hz, E1-10=increase if necessary, E1-08=increase if necessary
- 0.01Hz resolution of speed references is required for better resolution in speed control.

We also need particular settings in the PLC side : following bits have to be cleared : IR209.0=0 and IR209.1=0. In this way we provide full Speed reference and Run command control from the PLC regardless the inverter settings.

And the configuration for the input encoder (24Vdc type).

For the counter to work with the encoder we need following settings :



B-4-6 I/O CONNECTIONS

In the template following basic inputs are predefined:

- PLC Input 0 : A Channel encoder
- PLC Input 1 : B Channel encoder
- PLC Input 2 : Home/Origin sensor

Then the user program can use the rest of PLC and inverter inputs …

In our Application example we use :

- PLC Input 3 for Home/Origin request and
- PLC Input 4 for positioning

B-4-7 DEFINING THE APPLICATION

When counting for the required accuracy a safe rule is to count on 20-30 quad edge pulse error directly on the motor. Depends mostly on the mechanical system design.

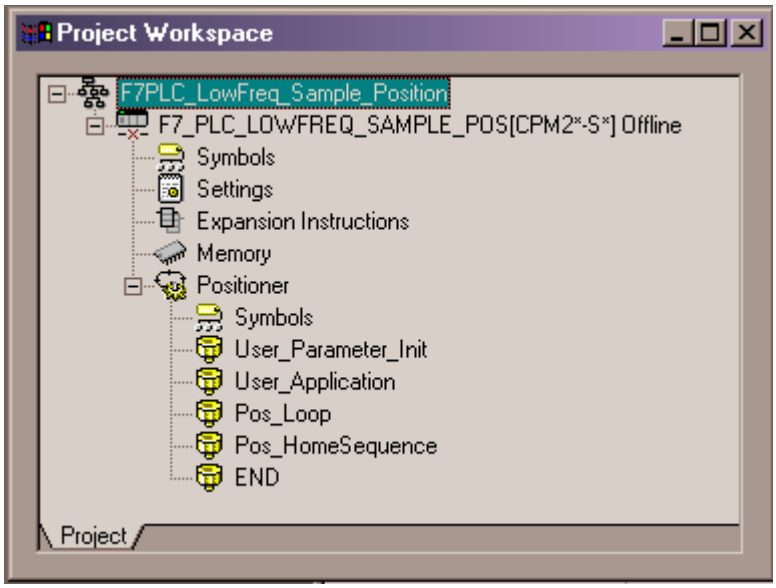
The encoder can be either in the motor or after gearbox. For higher accuracy in the motor is good, but then we have to be careful with the frequency limits of the input.

In any case take into account the 5KHz maximum input rate for the maximum motor speed. Depends on the encoder resolution, where it is placed and encoder max rpm. Typical figure is for a 1500rpm motor, with encoder directly coupled to motor that we can use a 200ppr encoder if we require full speed range : This is 5KHz at top speed.

B-4-8 PROGRAM STRUCTURE

Two main sections have to be added to the end of the PLC program:

- ***Pos_Loop*** provides the position/speed control capabilities,
- ***Pos_HomeSequence*** provides the home sequence facilities.



- ***User_Parameter_Init*** will be used by the customer to initialise Position program parameters and application own parameters
- ***User_Application*** will make use of the control bits and parameters of the Positioning template to do the machine sequence. If the user program has more sections all have to be in front of the Pos_??? sections.

B-4-9 SETTING POSITION PARAMETERS

The software provides the following BIT/WORD interface area and default values ….

NOTE: as the reading of the encoder signal comes from quadrature signals, the name quads refers to four counts for each encoder pulse…. It means a 200ppr encoder will provide a real resolution of 800 quads per revolution…. The frequency limit is defined by the real pulse limit, not quads.

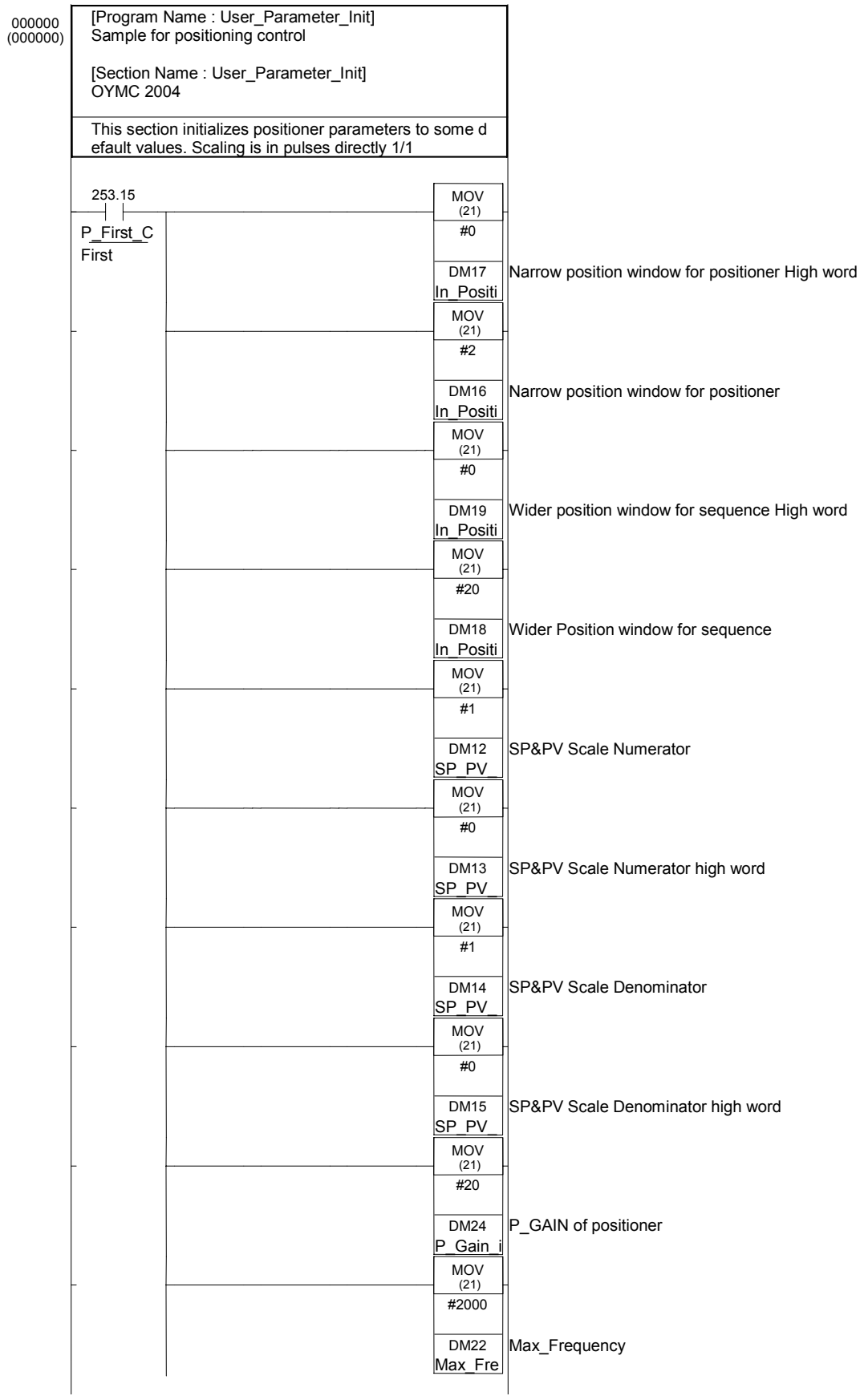
It is recommended to first do a trial run in speed with small reference and check that the counting of the encoder corresponds to speed reference given. If not some wiring might be wrong. Once positive sense corresponds to positive count, then we can go for the positioner settings.

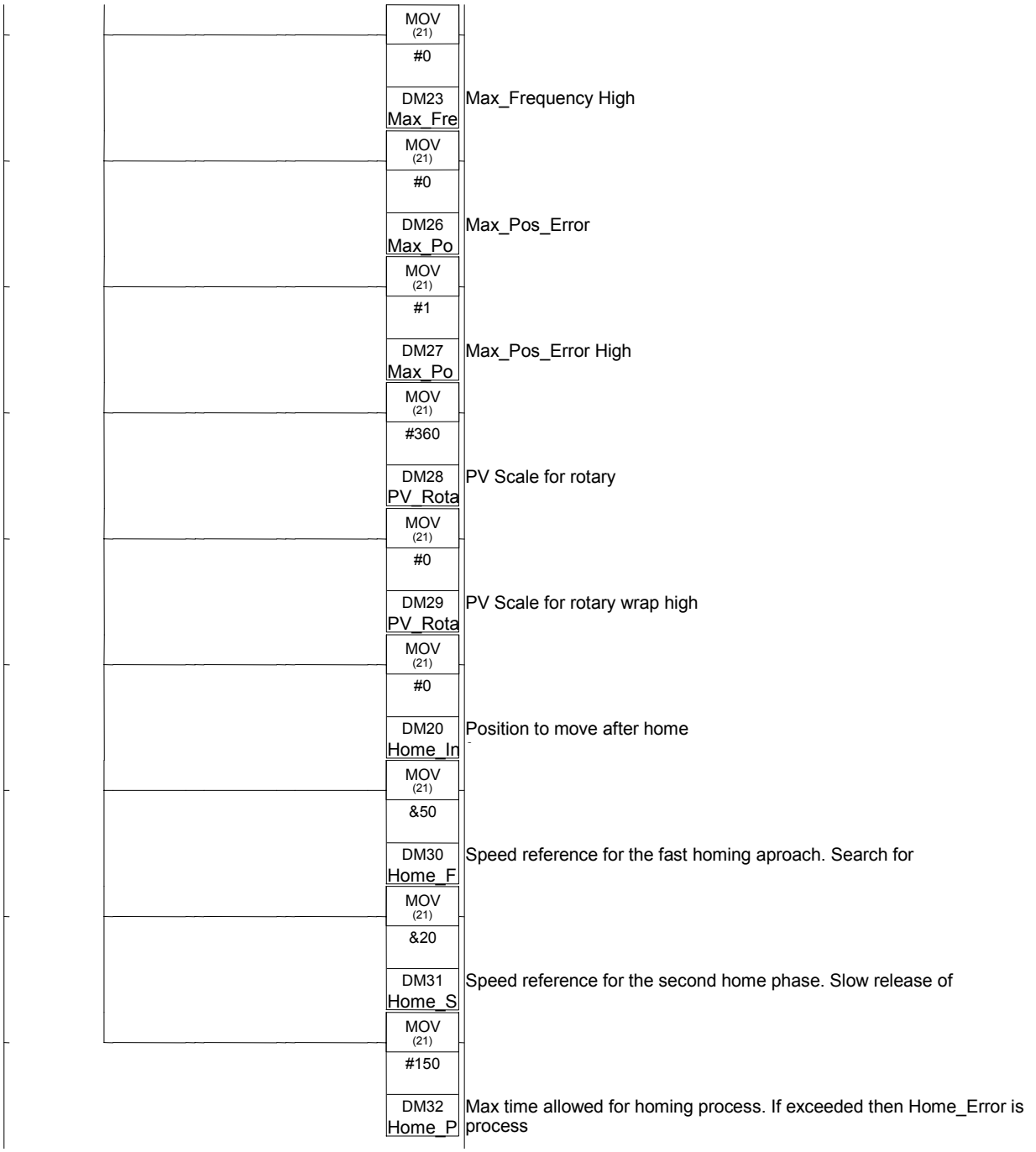
PARAMETER	Type	Description	Default Value
2.0	BIT (R/W)	Control_Mode : 0=Speed, 1=Position	0
2.1	BIT (R/W)	Position_Reset : 1=reset . Use with SET. Resets to zero when done	0
2.2	BIT (R/W)	Home_Request : 1=Home is requested. The sequence begins. Once finished we can have either 3.0=1 (Home_OK) or 3.1=1 (Home_Error). The maximum time to perform home is defined in DM32	0
2.3	BIT (R/W)	Speed_Run_Fwd : In Speed mode (2.0=0), it generates Run forward of the inverter with 2.3=1. The speed reference from DM2036. 209.0=0 and 209.1=0 for full PLC control.	0
2.4	BIT (R/W)	Speed_Run_Rev : Like 2.3, but in reverse direction	0
2.0	BIT (R)	Home_OK : When home is finished and OK, this bit is activated	--
3.1	BIT (R)	Home_Error : If home is not finished in the defined timeout DM32, then Home_Error appears and the sequence is cancelled.	--
3.2	BIT (R)	In_Position1 : The finest in position. Defined window in DM16. Used for the positioner work itself.	--
3.3	BIT (R)	In_Position2 : Available for fastest sequence work. We define in DM18. Typically used to start processes slightly before the final position is reached (activate a valve, move other axis, etc….).	--

PARAMETER	Type	Description	Default Value
DM0010	DWORD (R/W) BCD	SP : BCD. SetPoint of position (in units) DM10 and DM11	0
DM0012	DWORD (R/W) BCD	SP_PV_Scale_N1 : Numerator of SP&PV scaling	1
DM0014	DWORD (R/W) BCD	SP_PV_Scale_N2 : Denominator of SP&PV scaling Scaling is.. $\text{units} * \frac{N1}{N2} = \text{quads}$ Default values correspond to direct quad control	1
DM0016	DWORD (R/W) BCD	In_Position1_Window : Defines the width of the In_Position output 1. This has to be the most accurate positioning window. Usually just some units.In units	2
DM0018	DWORD (R/W) BCD	In_Position2_Window : Defines a wider window for use in the software sequence (start some actions just while the movement is being finished). In quads	20
DM0020	DWORD (R/W) BCD	Home_Initial_Pos : In units. Defines the initial movement to an initial position <>0 after the homing process has been defined.	0
DM0022	DWORD (R/W) Decimal	Max_Frequency : Value in speed units from the inverter (0.01Hz).	2000
DM0024	DWORD (R/W) BCD	P_Gain : This is the factor that will generate the final speed reference from the position error quads. If it is too big we will have overshoot. If too low, positioning will be slow. If we have big inertia it might happen that even with small gain we have instability.	10
DM0026	DWORD (R/W) BCD	Max_Pos_Error : This limits the error output. This is necessary mainly for calculation limit issues.	10000
DM0028	DWORD (R/W) BCD	PV_Rotary_Scale : This is an additional “Present Value” readout that shows in DM44 (Dword) Whole DM28 groups of counts and in DM46 (Dword) the remaining in one “wrap around count”. If we use a scaling for degrees and DM28 is 360, then is just turns/degrees idea.	360
DM0030	WORD (R/W) Decimal	Home_Fast_Speed : This is the first speed used to find the home/origin sensor in reverse sense. Decimal value in 0.01Hz units.	50
DM0031	WORD (R/W) Decimal	Home_Seek_Speed : Once found the sensor, forward seek at this speed is performed until the sensor disappears. This ensure accurate homing. Decimal value in 0.01Hz units.	20
DM0032	WORD (R/W) BCD	Home_Process_MaxTime : Timeout value in 0.1 sec unit. This is the allowed time for the homing process to finish.	150
DM002036	WORD (R/W) Decimal	MV_Freq_Ref_Set : This is the speed reference when the PLC is controlling the inverter. In position mode (2.0=1) The program generates automatically this reference. In speed mode (2.0=0) the user has to set the value to control the speed.	100
DM0040	DWORD (R) BCD	PV_Final : Scaled Present Value. Real position read from the encoder. Scaling factors to/from quads in DM12 / DM14	--
DM0044	DWORD (R) BCD	PV_Whole_Turns : Scaled PV with “wrap around” function from DM28	--
DM0046	DWORD (R) BCD	PV_Angular_Position : Scaled PV with “wrap around” function from DM28	--

B-4-10 Ladder/Mnemonics

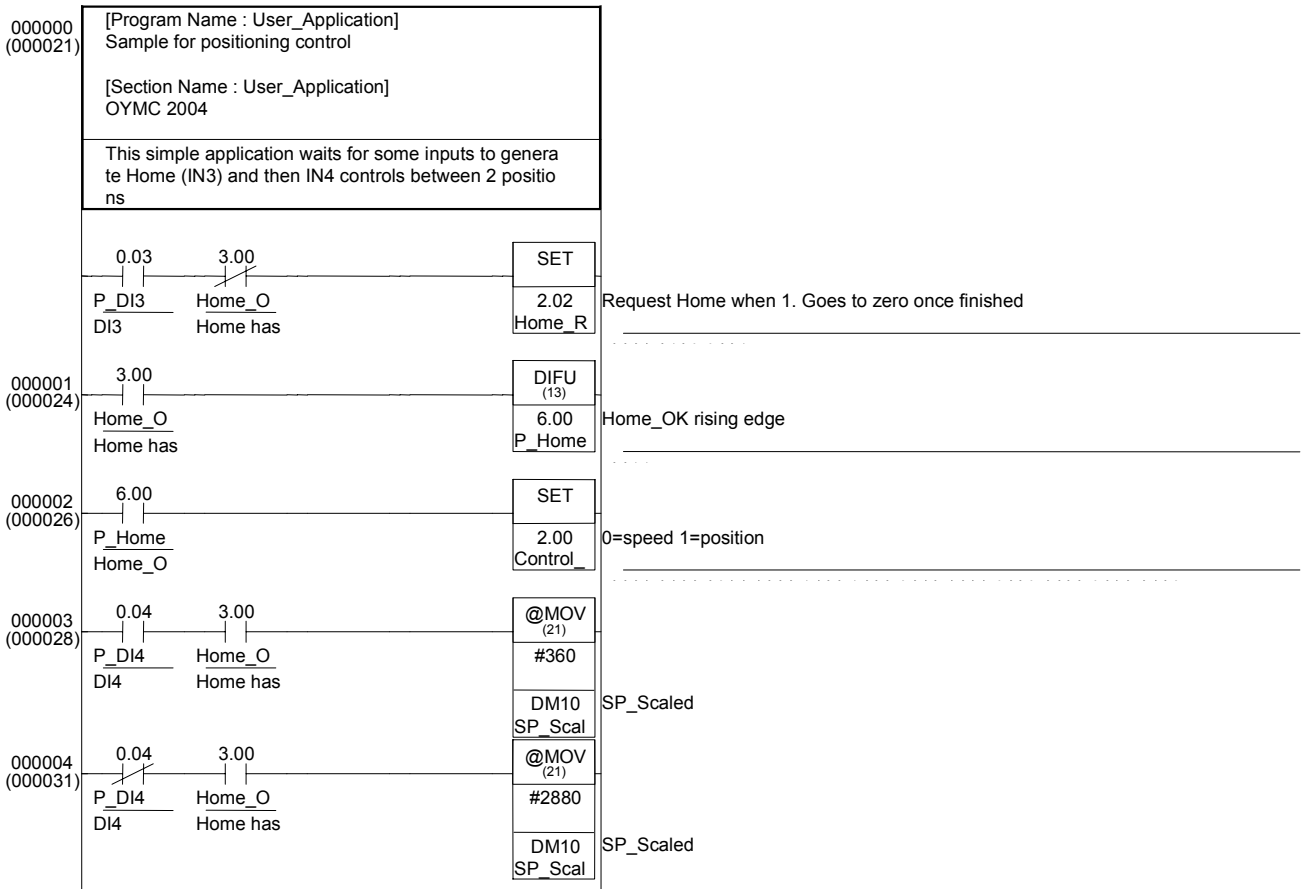
User_parameter_Init




MOV (21)
#0
DM23 Max_Fre
Max_Frequency High
MOV (21)
#0
DM26 Max_Po
Max_Pos_Error
MOV (21)
#1
DM27 Max_Po
Max_Pos_Error High
MOV (21)
#360
DM28 PV_Rota
PV Scale for rotary
MOV (21)
#0
DM29 PV_Rota
PV Scale for rotary wrap high
MOV (21)
#0
DM20 Home_In
Position to move after home
MOV (21)
&50
DM30 Home_F
Speed reference for the fast homing aproach. Search for
MOV (21)
&20
DM31 Home_S
Speed reference for the second home phase. Slow release of
MOV (21)
#150
DM32 Home_P
Max time allowed for homing process. If exceeded then Home_Error is process

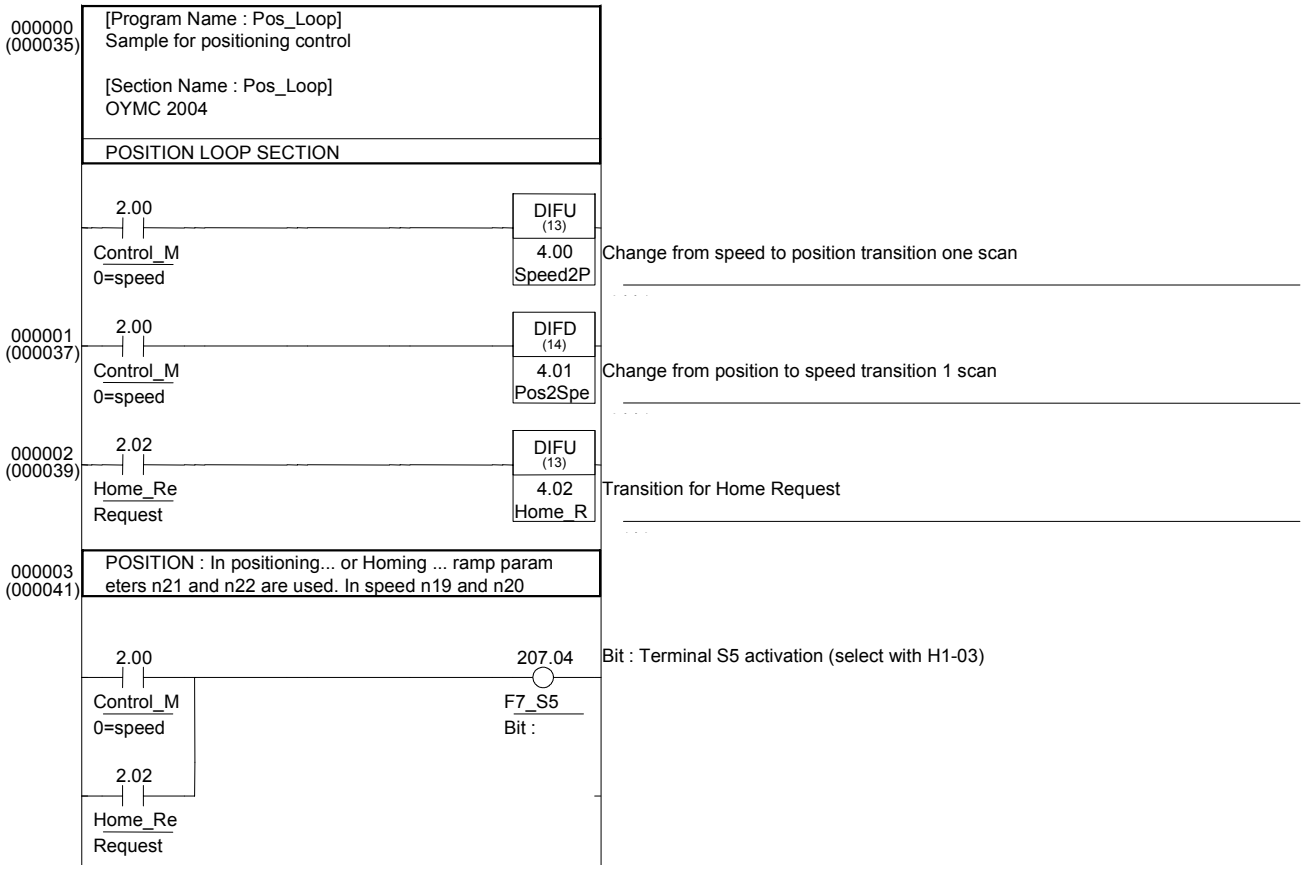
```
'  This section initializes positioner parameters to some default values. Scaling is in pulses
directly 1/1
LD P_First_Cycle
MOV(21) #0 In_Position1_Window_H
MOV(21) #2 In_Position1_Window
MOV(21) #0 In_Position2_Window_H
MOV(21) #20 In_Position2_Window
MOV(21) #1 SP_PV_Scale_N1
MOV(21) #0 SP_PV_Scale_N1_H
MOV(21) #1 SP_PV_Scaled_N2
MOV(21) #0 SP_PV_Scaled_N2_H
MOV(21) #20 P_Gain_in_Tenth
MOV(21) #2000 Max_Frequency
MOV(21) #0 Max_Frequency_H
MOV(21) #0 Max_Pos_Error
MOV(21) #1 Max_Pos_Error_H
MOV(21) #360 PV_Rotary_Scale
MOV(21) #0 PV_Rotary_Scale_H
MOV(21) #0 Home_Initial_Pos
MOV(21) &50 Home_Fast_Speed
MOV(21) &20 Home_Seek_Speed
MOV(21) #150 Home_Process_MaxTime
```

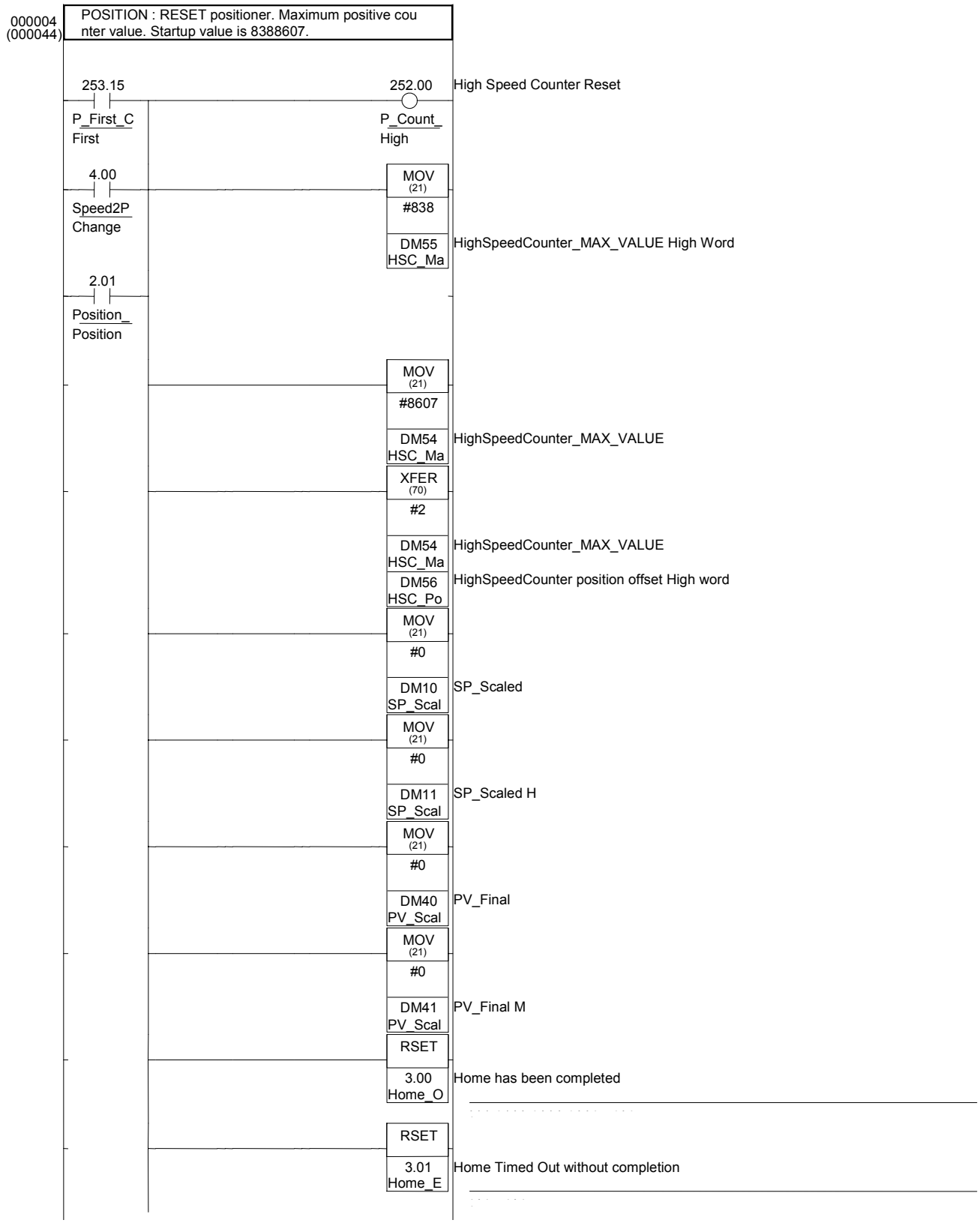
User_Application

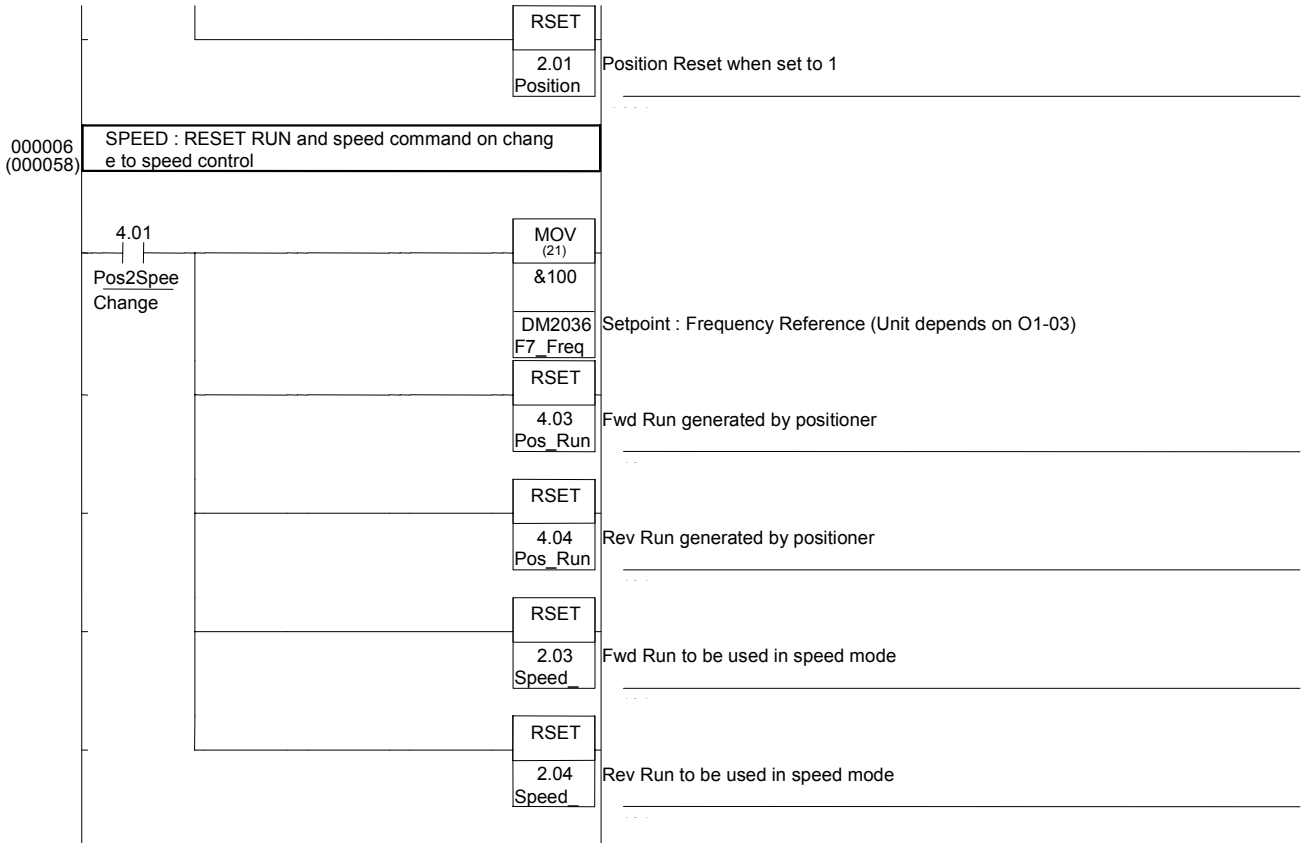


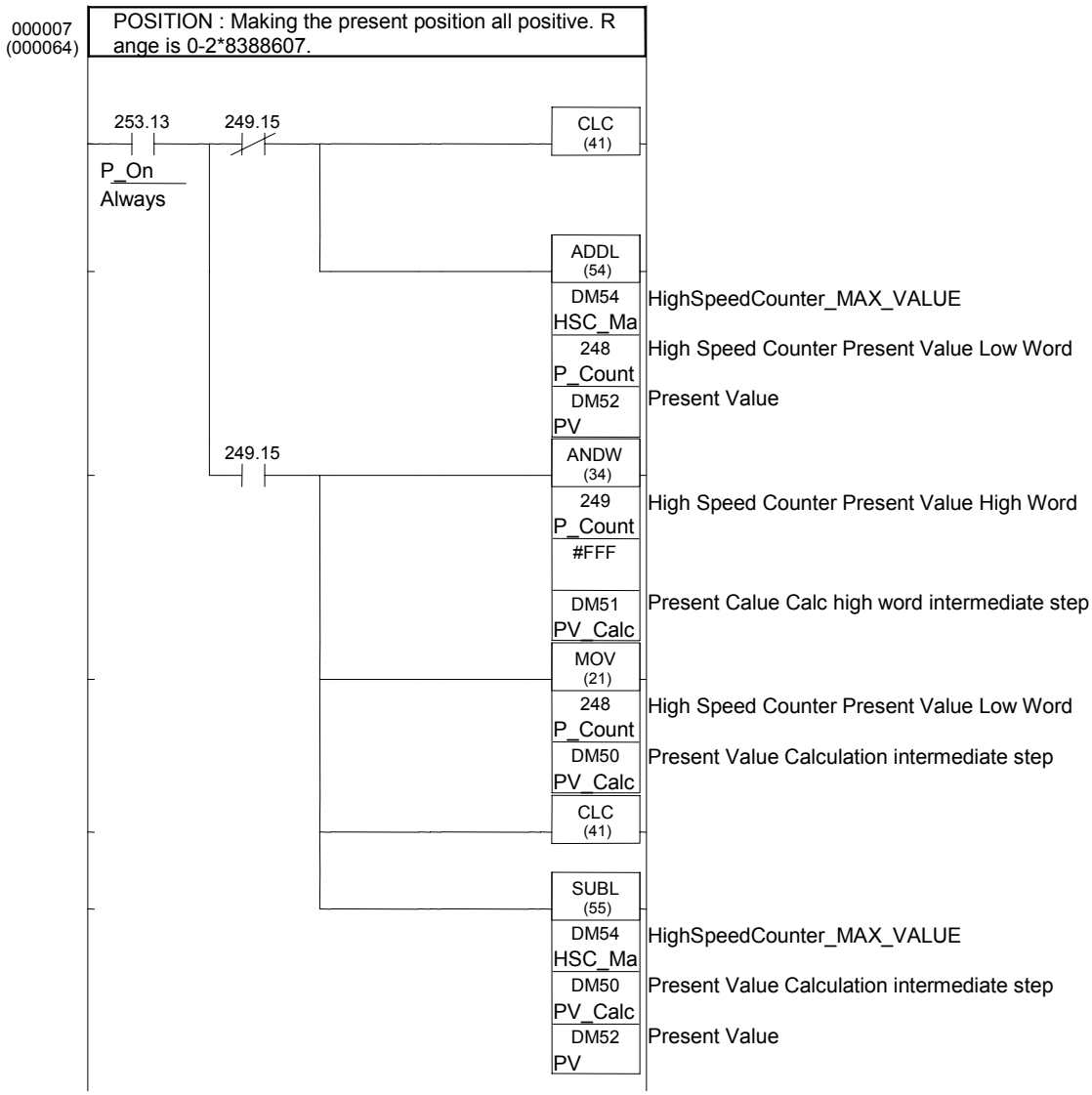

```
'  This simple application waits for some inputs to generate Home (IN3) and then IN4 controls
between 2 positions
LD P_DI3
ANDNOT Home_OK
SET Home_Request
LD Home_OK
DIFU(13) P_HomeOK_Edge
LD P_HomeOK_Edge
SET Control_Mode
LD P_DI4
AND Home_OK
@MOV(21) #360 SP_Scaled
LDNOT P_DI4
AND Home_OK
@MOV(21) #2880 SP_Scaled
```

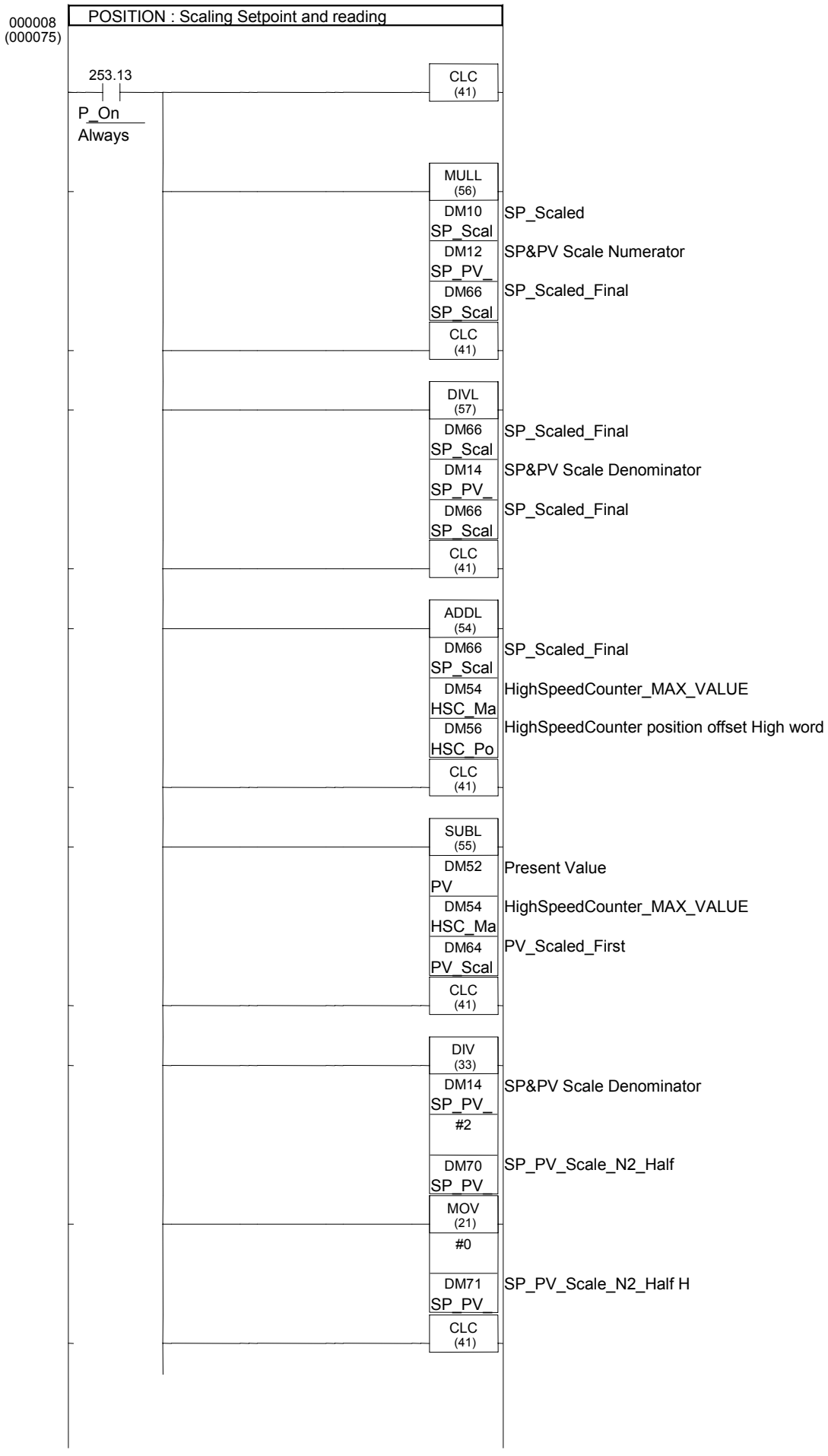
Pos_Loop

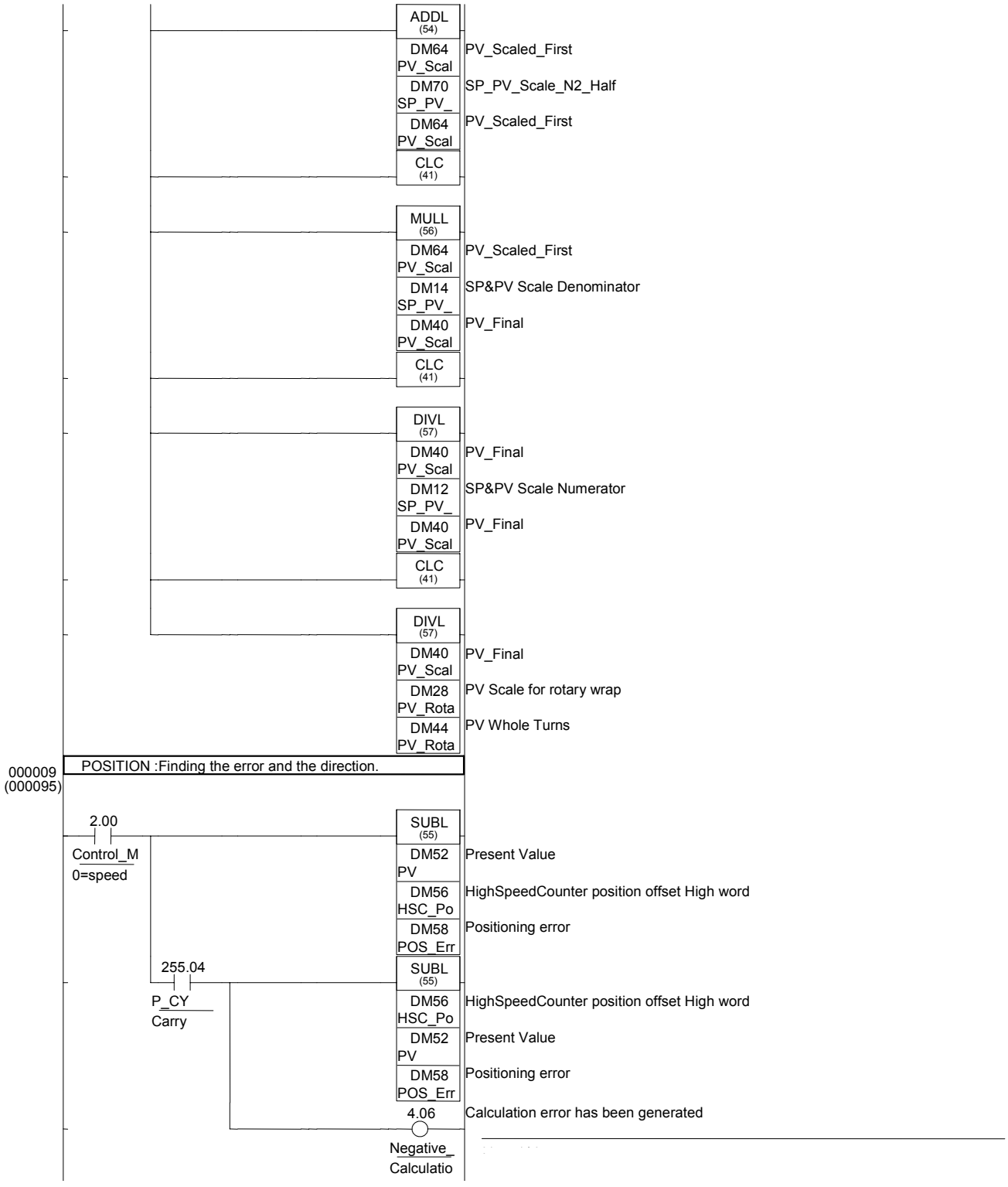

000000
(000035)
[Program Name : Pos_Loop]
Sample for positioning control
[Section Name : Pos_Loop]
OYMC 2004
POSITION LOOP SECTION
2.00
Control_M
0=speed
DIFU
(13)
4.00
Speed2P
Change from speed to position transition one scan
000001
(000037)
2.00
Control_M
0=speed
DIFD
(14)
4.01
Pos2Spe
Change from position to speed transition 1 scan
000002
(000039)
2.02
Home_Re
Request
DIFU
(13)
4.02
Home_R
Transition for Home Request
000003
(000041)
POSITION : In positioning... or Homing ... ramp param
eters n21 and n22 are used. In speed n19 and n20
2.00
Control_M
0=speed
2.02
Home_Re
Request
207.04
F7_S5
Bit :
Bit : Terminal S5 activation (select with H1-03)

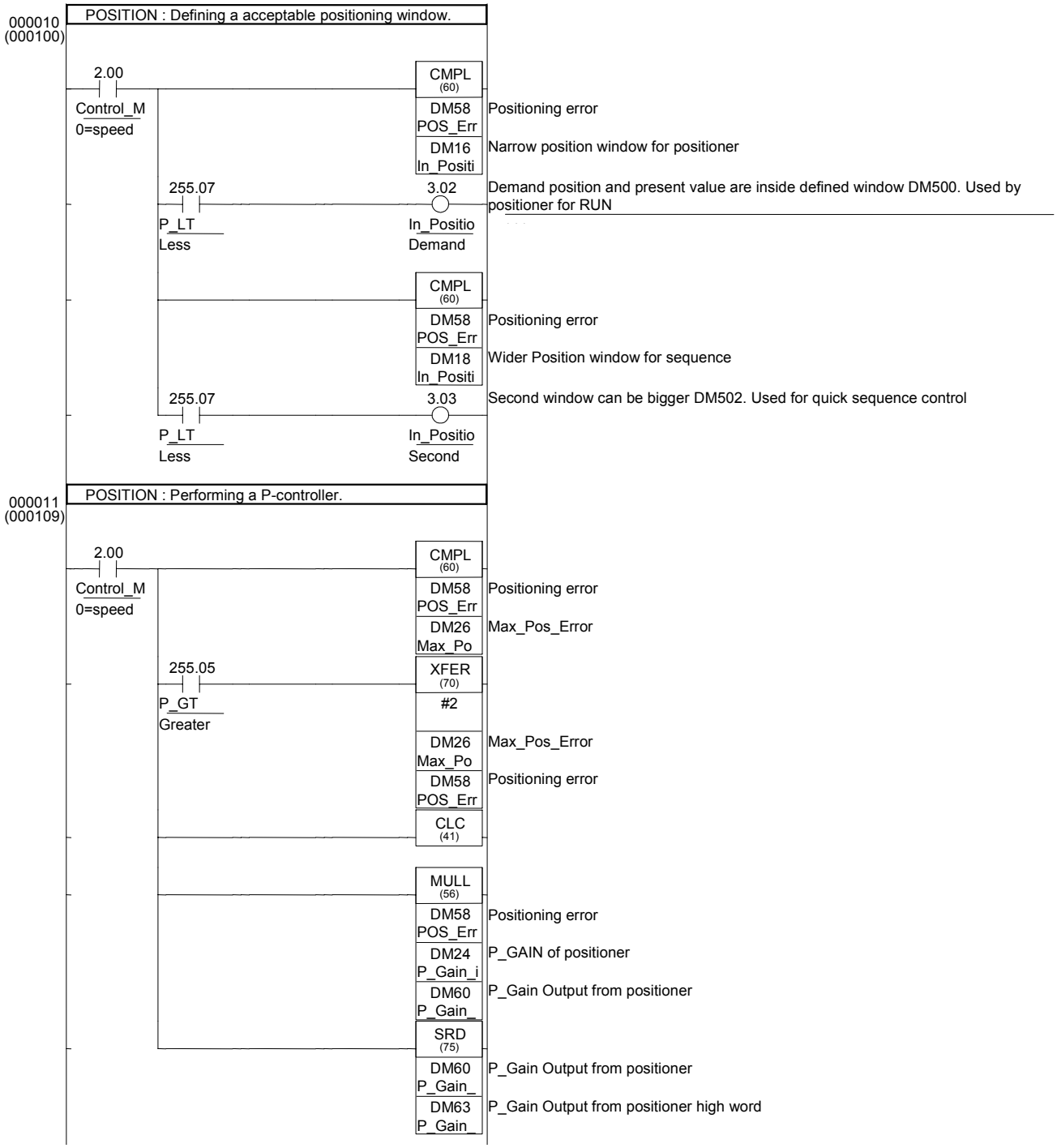

000004
(000044)
POSITION : RESET positioner. Maximum positive cou
nter value. Startup value is 8388607.
253.15
P_First_C
First
252.00
P_Count_
High
High Speed Counter Reset
4.00
Speed2P
Change
MOV
(21)
#838
DM55
HSC_Ma
HighSpeedCounter_MAX_VALUE High Word
2.01
Position_
Position
MOV
(21)
#8607
DM54
HSC_Ma
HighSpeedCounter_MAX_VALUE
XFER
(70)
#2
DM54
HSC_Ma
HighSpeedCounter_MAX_VALUE
DM56
HSC_Po
HighSpeedCounter position offset High word
MOV
(21)
#0
DM10
SP_Scal
SP_Scaled
MOV
(21)
#0
DM11
SP_Scal
SP_Scaled H
MOV
(21)
#0
DM40
PV_Scal
PV_Final
MOV
(21)
#0
DM41
PV_Scal
PV_Final M
RSET
3.00
Home_O
Home has been completed
RSET
3.01
Home_E
Home Timed Out without completion

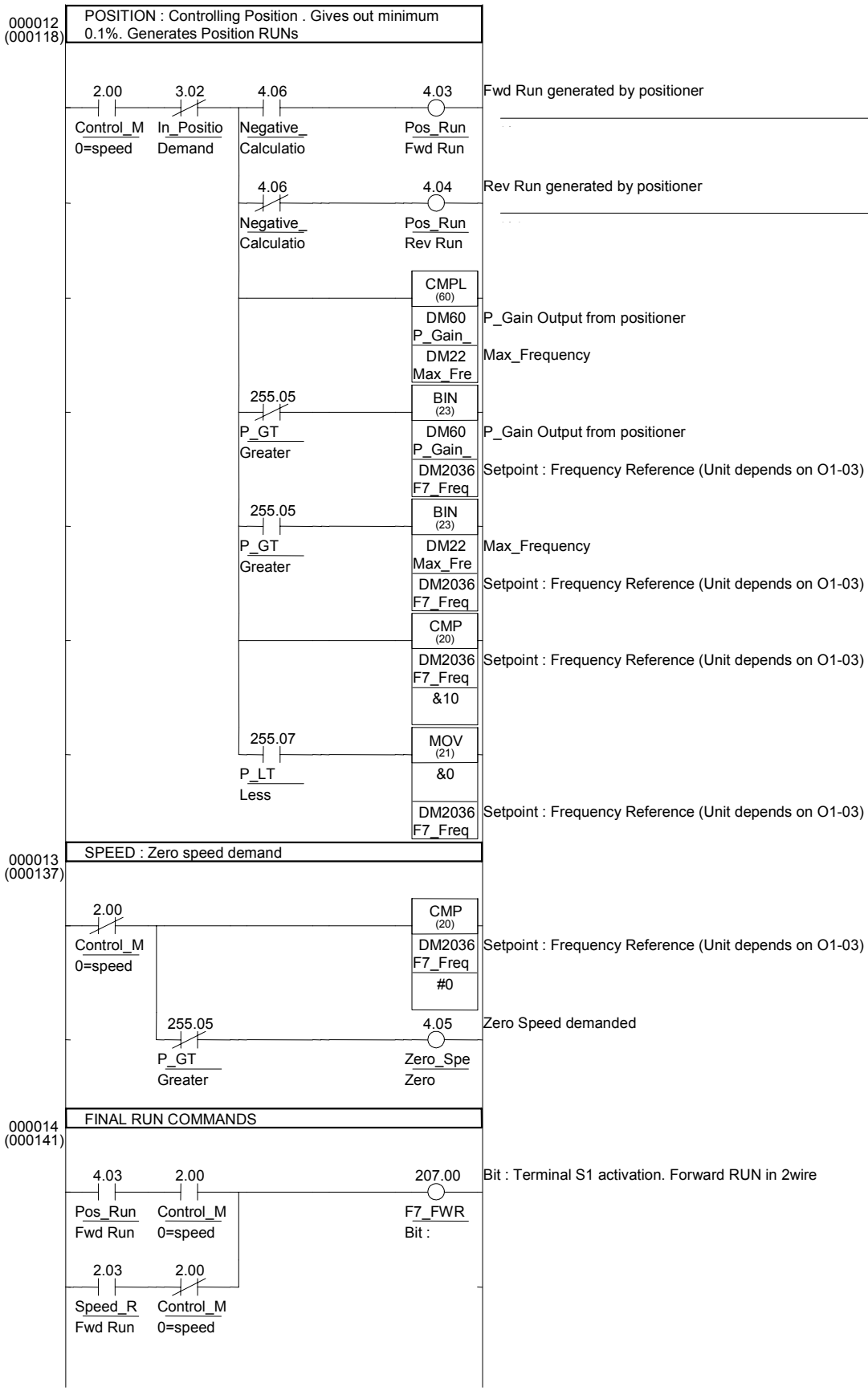

RSET
2.01
Position
Position Reset when set to 1
000006
(000058)
SPEED : RESET RUN and speed command on chang
e to speed control
4.01
Pos2Spee
Change
MOV
(21)
&100
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
RSET
4.03
Pos_Run
Fwd Run generated by positioner
RSET
4.04
Pos_Run
Rev Run generated by positioner
RSET
2.03
Speed_
Fwd Run to be used in speed mode
RSET
2.04
Speed_
Rev Run to be used in speed mode

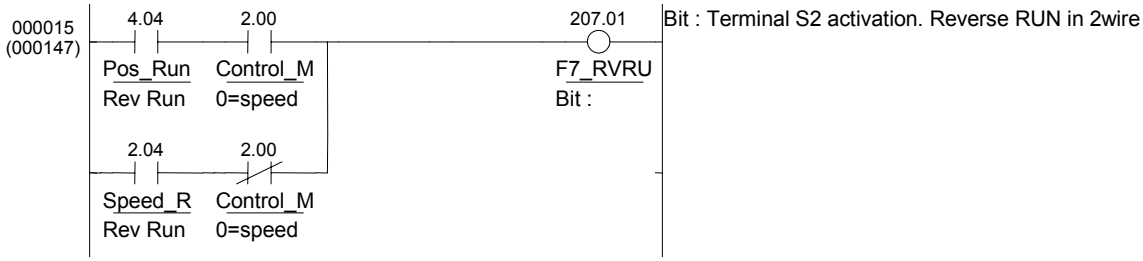

000007
(000064)
POSITION : Making the present position all positive. R
ange is 0-2*8388607.
253.13
P_On
Always
249.15
CLC
(41)
ADDL
(54)
DM54
HSC_Ma
HighSpeedCounter_MAX_VALUE
248
P_Count
High Speed Counter Present Value Low Word
DM52
PV
Present Value
249.15
ANDW
(34)
249
P_Count
High Speed Counter Present Value High Word
#FFF
DM51
PV_Calc
Present Calue Calc high word intermediate step
MOV
(21)
248
P_Count
High Speed Counter Present Value Low Word
DM50
PV_Calc
Present Value Calculation intermediate step
CLC
(41)
SUBL
(55)
DM54
HSC_Ma
HighSpeedCounter_MAX_VALUE
DM50
PV_Calc
Present Value Calculation intermediate step
DM52
PV
Present Value


000008
(000075)
POSITION : Scaling Setpoint and reading
253.13
P_On
Always
CLC (41)
MULL (56)
DM10 SP_Scal
SP_Scaled
DM12 SP_PV_
SP&PV Scale Numerator
DM66 SP_Scal
SP_Scaled_Final
CLC (41)
DIVL (57)
DM66 SP_Scal
SP_Scaled_Final
DM14 SP_PV_
SP&PV Scale Denominator
DM66 SP_Scal
SP_Scaled_Final
CLC (41)
ADDL (54)
DM66 SP_Scal
SP_Scaled_Final
DM54 HSC_Ma
HighSpeedCounter_MAX_VALUE
DM56 HSC_Po
HighSpeedCounter position offset High word
CLC (41)
SUBL (55)
DM52 PV
Present Value
DM54 HSC_Ma
HighSpeedCounter_MAX_VALUE
DM64 PV_Scal
PV_Scaled_First
CLC (41)
DIV (33)
DM14 SP_PV_
SP&PV Scale Denominator
#2
DM70 SP_PV_
SP_PV_Scale_N2_Half
MOV (21)
#0
DM71 SP_PV_
SP_PV_Scale_N2_Half H
CLC (41)


ADDL (54)
DM64 PV_Scal
PV_Scaled_First
DM70 SP_PV_
SP_PV_Scale_N2_Half
DM64 PV_Scal
PV_Scaled_First
CLC (41)
MULL (56)
DM64 PV_Scal
PV_Scaled_First
DM14 SP_PV_
SP&PV Scale Denominator
DM40 PV_Scal
PV_Final
CLC (41)
DIVL (57)
DM40 PV_Scal
PV_Final
DM12 SP_PV_
SP&PV Scale Numerator
DM40 PV_Scal
PV_Final
CLC (41)
DIVL (57)
DM40 PV_Scal
PV_Final
DM28 PV_Rota
PV Scale for rotary wrap
DM44 PV_Rota
PV Whole Turns
000009 (000095)
POSITION :Finding the error and the direction.
2.00
Control_M
0=speed
SUBL (55)
DM52 PV
Present Value
DM56 HSC_Po
HighSpeedCounter position offset High word
DM58 POS_Err
Positioning error
255.04
P_CY
Carry
SUBL (55)
DM56 HSC_Po
HighSpeedCounter position offset High word
DM52 PV
Present Value
DM58 POS_Err
Positioning error
4.06
Negative_
Calculatio
Calculation error has been generated


000010
(000100)
POSITION : Defining a acceptable positioning window.
2.00
Control_M
0=speed
CMPL
(60)
DM58
POS_Err
Positioning error
DM16
In_Positi
Narrow position window for positioner
255.07
P_LT
Less
3.02
In_Positio
Demand
Demand position and present value are inside defined window DM500. Used by positioner for RUN
CMPL
(60)
DM58
POS_Err
Positioning error
DM18
In_Positi
Wider Position window for sequence
255.07
P_LT
Less
3.03
In_Positio
Second
Second window can be bigger DM502. Used for quick sequence control
000011
(000109)
POSITION : Performing a P-controller.
2.00
Control_M
0=speed
CMPL
(60)
DM58
POS_Err
Positioning error
DM26
Max_Po
Max_Pos_Error
255.05
P_GT
Greater
XFER
(70)
#2
DM26
Max_Po
Max_Pos_Error
DM58
POS_Err
Positioning error
CLC
(41)
MULL
(56)
DM58
POS_Err
Positioning error
DM24
P_Gain_i
P_GAIN of positioner
DM60
P_Gain_
P_Gain Output from positioner
SRD
(75)
DM60
P_Gain_
P_Gain Output from positioner
DM63
P_Gain_
P_Gain Output from positioner high word

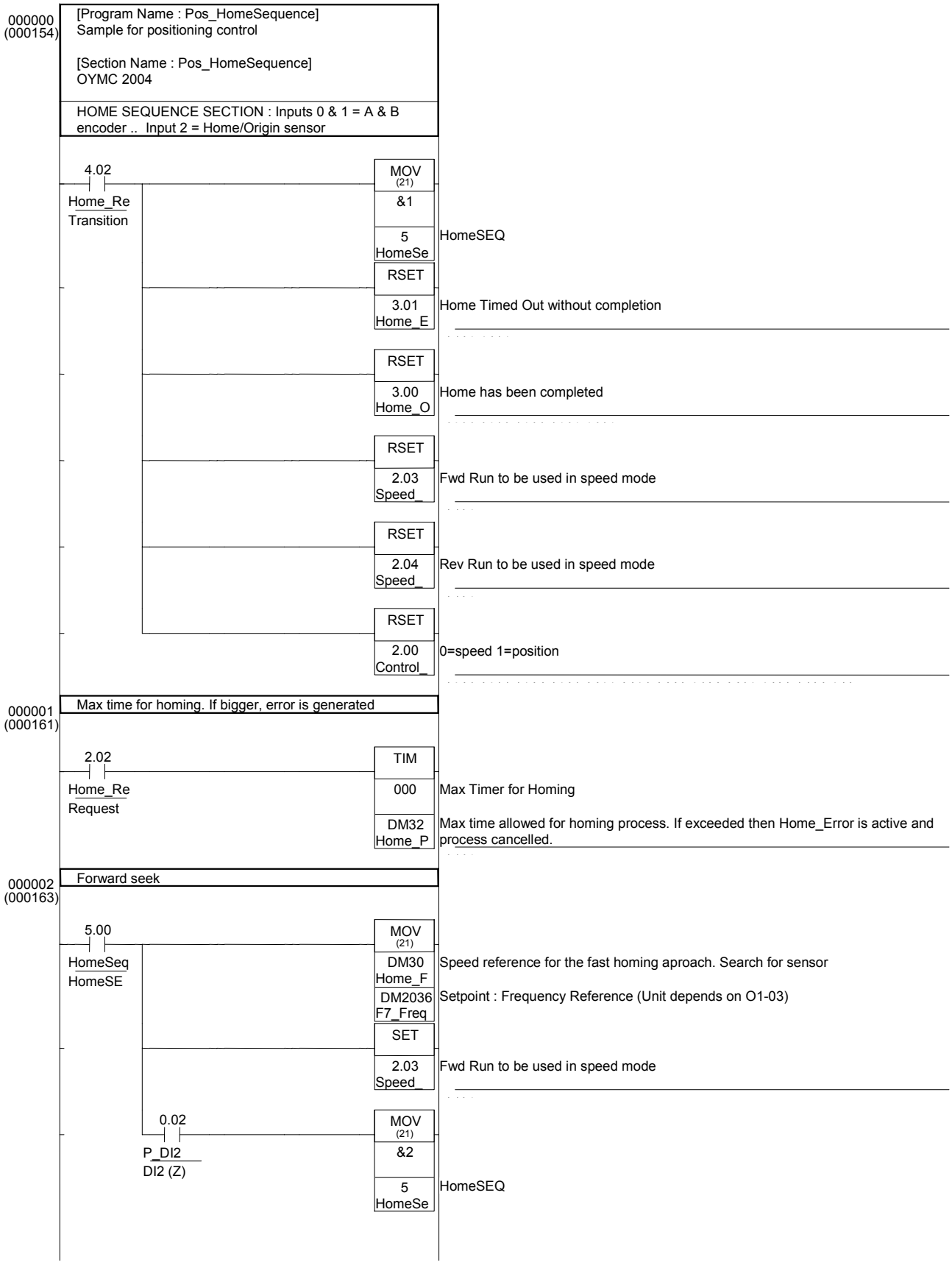

000012
(000118)
POSITION : Controlling Position . Gives out minimum 0.1%. Generates Position RUNs
2.00
Control_M
0=speed
3.02
In_Positio
Demand
4.06
Negative_
Calculatio
4.03
Pos_Run
Fwd Run
Fwd Run generated by positioner
4.06
Negative_
Calculatio
4.04
Pos_Run
Rev Run
Rev Run generated by positioner
CMPL
(60)
DM60
P_Gain_
P_Gain Output from positioner
DM22
Max_Fre
Max_Frequency
255.05
P_GT
Greater
BIN
(23)
DM60
P_Gain_
P_Gain Output from positioner
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
255.05
P_GT
Greater
BIN
(23)
DM22
Max_Fre
Max_Frequency
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
CMP
(20)
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
&10
255.07
P_LT
Less
MOV
(21)
&0
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
000013
(000137)
SPEED : Zero speed demand
2.00
Control_M
0=speed
CMP
(20)
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
#0
255.05
P_GT
Greater
4.05
Zero_Spe
Zero
Zero Speed demanded
000014
(000141)
FINAL RUN COMMANDS
4.03
Pos_Run
Fwd Run
2.00
Control_M
0=speed
207.00
F7_FWR
Bit :
Bit : Terminal S1 activation. Forward RUN in 2wire
2.03
Speed_R
Fwd Run
2.00
Control_M
0=speed

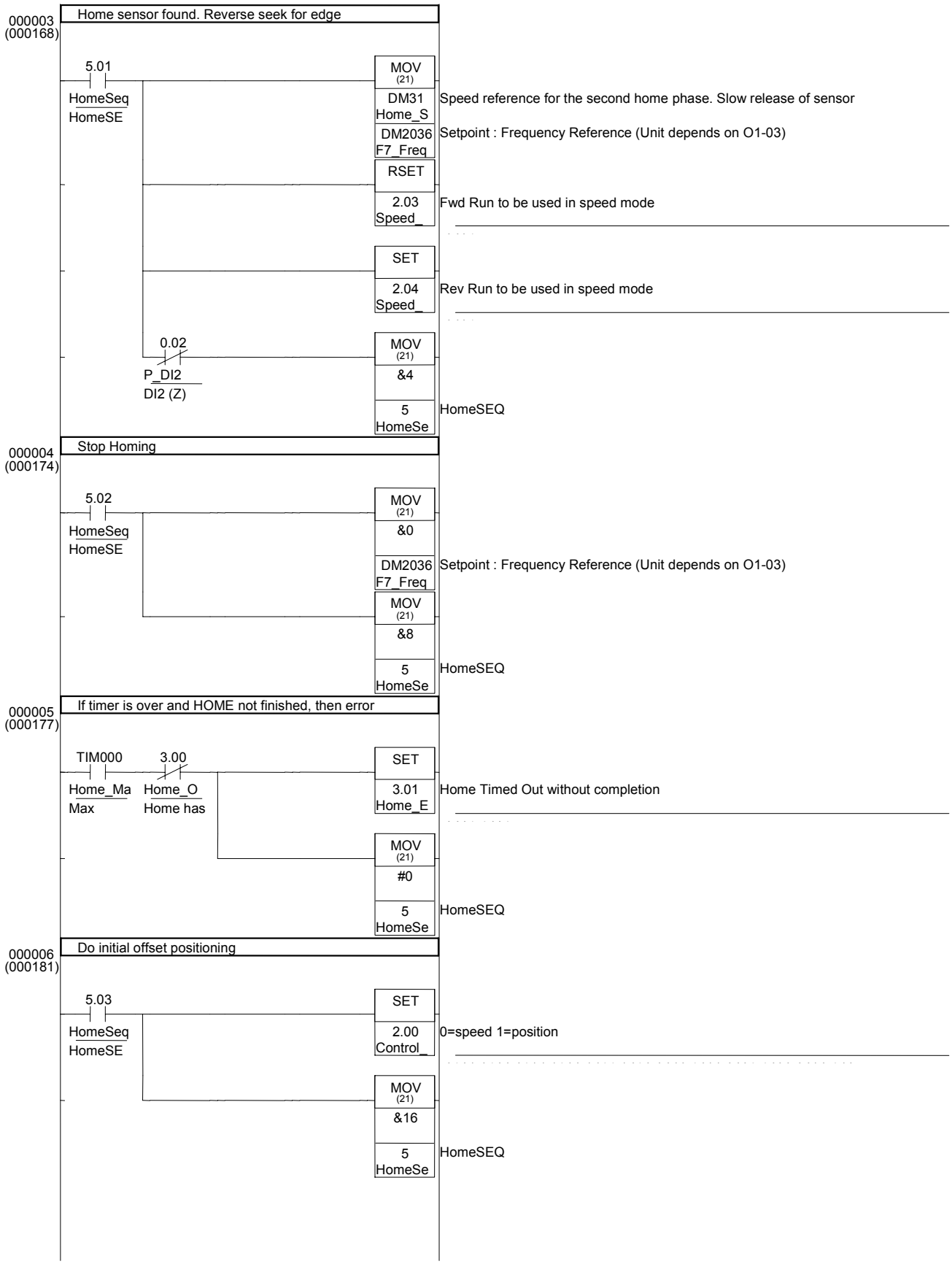


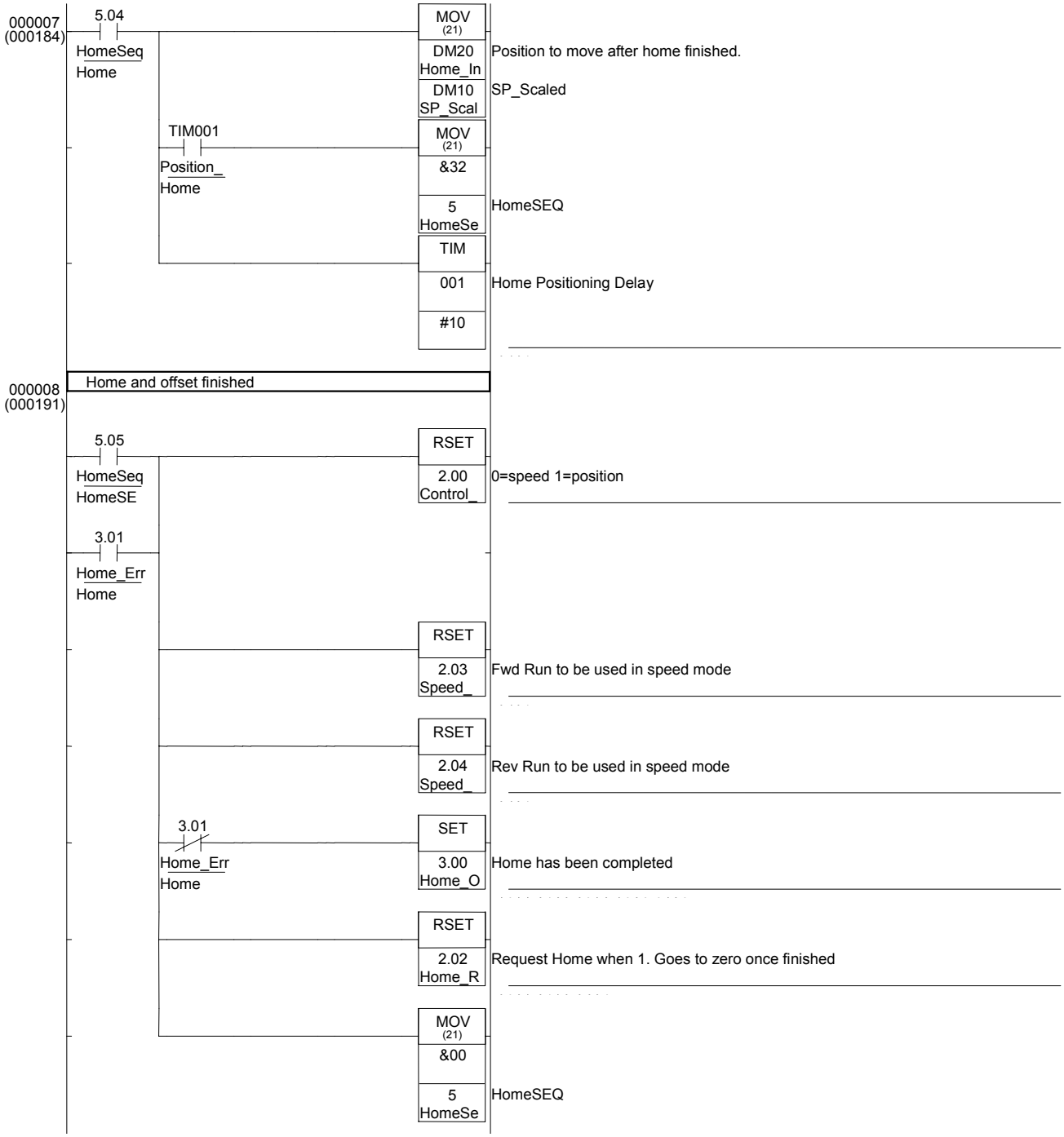

```
'  POSITION LOOP SECTION
LD Control_Mode
DIFU(13) Speed2Pos
LD Control_Mode
DIFD(14) Pos2Speed
LD Home_Request
DIFU(13) Home_Req_Change
'  POSITION : In positioning... or Homing ... ramp parameters n21 and n22 are used. In speed
n19 and n20
LD Control_Mode
OR Home_Request
OUT F7_S5
'  POSITION : RESET positioner. Maximum positive counter value. Startup value is 8388607.
LD P_First_Cycle
OR Speed2Pos
OR Position_Reset
OUT P_Count_Reset
MOV(21) #838 HSC_Max_Value_H
MOV(21) #8607 HSC_Max_Value
XFER(70) #2 HSC_Max_Value HSC_Pos_Offset
MOV(21) #0 SP_Scaled
MOV(21) #0 SP_Scaled_H
MOV(21) #0 PV_Scaled_Final
MOV(21) #0 PV_Scale_Final_M
RSET Home_OK
RSET Home_Error
RSET Position_Reset
'  SPEED : RESET RUN and speed command on change to speed control
LD Pos2Speed
MOV(21) &100 F7_Freq_Ref_Set
RSET Pos_Run_Fwd
RSET Pos_Run_Rev
RSET Speed_Run_Fwd
RSET Speed_Run_Rev
'  POSITION : Making the present position all positive. Range is 0-2*8388607.
LD P_On
OUT TR0
ANDNOT 249.15
CLC(41)
ADDL(54) HSC_Max_Value P_Count_PV_Lo PV
LD TR0
AND 249.15
ANDW(34) P_Count_PV_Hi #FFF PV_Calc_H
MOV(21) P_Count_PV_Lo PV_Calc
CLC(41)
SUBL(55) HSC_Max_Value PV_Calc PV
'  POSITION : Scaling Setpoint and reading
LD P_On
CLC(41)
MULL(56) SP_Scaled SP_PV_Scale_N1 SP_Scaled_Final
CLC(41)
DIVL(57) SP_Scaled_Final SP_PV_Scaled_N2 SP_Scaled_Final
CLC(41)
ADDL(54) SP_Scaled_Final HSC_Max_Value HSC_Pos_Offset
CLC(41)
SUBL(55) PV HSC_Max_Value PV_Scaled_First
CLC(41)
DIV(33) SP_PV_Scaled_N2 #2 SP_PV_Scale_N2
MOV(21) #0 SP_PV_Scale_N2_H
CLC(41)
ADDL(54) PV_Scaled_First SP_PV_Scale_N2 PV_Scaled_First
CLC(41)
MULL(56) PV_Scaled_First SP_PV_Scaled_N2 PV_Scaled_Final
CLC(41)
DIVL(57) PV_Scaled_Final SP_PV_Scale_N1 PV_Scaled_Final
CLC(41)
DIVL(57) PV_Scaled_Final PV_Rotary_Scale PV_Rotary_Turns
'  POSITION :Finding the error and the direction.
```

```
LD Control_Mode
SUBL(55) PV HSC_Pos_Offset POS_Error
AND P_CY
SUBL(55) HSC_Pos_Offset PV POS_Error
OUT Negative_Error
'  POSITION : Defining a acceptable positioning window.
LD Control_Mode
OUT TR0
CMPL(60) POS_Error In_Position1_Window
AND P_LT
OUT In_Position1
LD TR0
CMPL(60) POS_Error In_Position2_Window
AND P_LT
OUT In_Position2
'  POSITION : Performing a P-controller.
LD Control_Mode
OUT TR0
CMPL(60) POS_Error Max_Pos_Error
AND P_GT
XFER(70) #2 Max_Pos_Error POS_Error
LD TR0
CLC(41)
MULL(56) POS_Error P_Gain_in_Tenth P_Gain_Out
SRD(75) P_Gain_Out P_Gain_Out_H
'  POSITION : Controlling Position . Gives out minimum 0.1%. Generates Position RUNs
LD Control_Mode
ANDNOT In_Position1
OUT TR0
AND Negative_Error
OUT Pos_Run_Fwd
LD TR0
ANDNOT Negative_Error
OUT Pos_Run_Rev
LD TR0
CMPL(60) P_Gain_Out Max_Frequency
ANDNOT P_GT
BIN(23) P_Gain_Out F7_Freq_Ref_Set
LD TR0
AND P_GT
BIN(23) Max_Frequency F7_Freq_Ref_Set
LD TR0
CMP(20) F7_Freq_Ref_Set &10
AND P_LT
MOV(21) &0 F7_Freq_Ref_Set
'  SPEED : Zero speed demand
LDNOT Control_Mode
CMP(20) F7_Freq_Ref_Set #0
ANDNOT P_GT
OUT Zero_Speed_Demand
'  FINAL RUN COMMANDS
LD Pos_Run_Fwd
AND Control_Mode
LD Speed_Run_Fwd
ANDNOT Control_Mode
ORLD
OUT F7_FWRUN_S1
LD Pos_Run_Rev
AND Control_Mode
LD Speed_Run_Rev
ANDNOT Control_Mode
ORLD
OUT F7_RVRUN_S2
```

Pos_HomeSequence



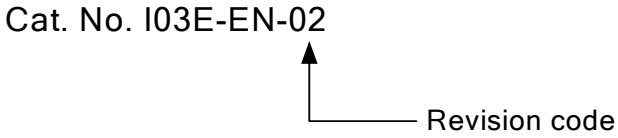

000003
(000168)
Home sensor found. Reverse seek for edge
5.01
HomeSeq
HomeSE
MOV
(21)
DM31
Home_S
Speed reference for the second home phase. Slow release of sensor
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
RSET
2.03
Speed_
Fwd Run to be used in speed mode
SET
2.04
Speed_
Rev Run to be used in speed mode
0.02
P_DI2
DI2 (Z)
MOV
(21)
&4
5
HomeSe
HomeSEQ
000004
(000174)
Stop Homing
5.02
HomeSeq
HomeSE
MOV
(21)
&0
DM2036
F7_Freq
Setpoint : Frequency Reference (Unit depends on O1-03)
MOV
(21)
&8
5
HomeSe
HomeSEQ
000005
(000177)
If timer is over and HOME not finished, then error
TIM000
Home_Ma
Max
3.00
Home_O
Home has
SET
3.01
Home_E
Home Timed Out without completion
MOV
(21)
#0
5
HomeSe
HomeSEQ
000006
(000181)
Do initial offset positioning
5.03
HomeSeq
HomeSE
SET
2.00
Control_
0=speed 1=position
MOV
(21)
&16
5
HomeSe
HomeSEQ


000007
(000184)
5.04
HomeSeq
Home
MOV
(21)
DM20
Home_In
Position to move after home finished.
DM10
SP_Scal
SP_Scaled
TIM001
Position_
Home
MOV
(21)
&32
5
HomeSe
HomeSEQ
TIM
001
Home Positioning Delay
#10
000008
(000191)
Home and offset finished
5.05
HomeSeq
HomeSE
RSET
2.00
Control_
0=speed 1=position
3.01
Home_Err
Home
RSET
2.03
Speed_
Fwd Run to be used in speed mode
RSET
2.04
Speed_
Rev Run to be used in speed mode
3.01
Home_Err
Home
SET
3.00
Home_O
Home has been completed
RSET
2.02
Home_R
Request Home when 1. Goes to zero once finished
MOV
(21)
&00
5
HomeSe
HomeSEQ

```
'  HOME SEQUENCE SECTION : Inputs 0 & 1 = A & B encoder ..  Input 2 = Home/Origin sensor
LD Home_Req_Change
MOV(21) &1 HomeSequence
RSET Home_Error
RSET Home_OK
RSET Speed_Run_Fwd
RSET Speed_Run_Rev
RSET Control_Mode
'  Max time for homing. If bigger, error is generated
LD Home_Request
TIM 000 Home_Process_MaxTime
'  Forward seek
LD HomeSeq1
MOV(21) Home_Fast_Speed F7_Freq_Ref_Set
SET Speed_Run_Fwd
AND P_DI2
MOV(21) &2 HomeSequence
'  Home sensor found. Reverse seek for edge
LD HomeSeq2
MOV(21) Home_Seek_Speed F7_Freq_Ref_Set
RSET Speed_Run_Fwd
SET Speed_Run_Rev
ANDNOT P_DI2
MOV(21) &4 HomeSequence
'  Stop Homing
LD HomeSeq3
MOV(21) &0 F7_Freq_Ref_Set
MOV(21) &8 HomeSequence
'  If timer is over and HOME not finished, then error
LD Home_Max_Time
ANDNOT Home_OK
SET Home_Error
MOV(21) #0 HomeSequence
'  Do initial offset positioning
LD HomeSeq4
SET Control_Mode
MOV(21) &16 HomeSequence
LD HomeSeq5
OUT TR0
MOV(21) Home_Initial_Pos SP_Scaled
AND Position_Delay
MOV(21) &32 HomeSequence
LD TR0
TIM 001 #10
'  Home and offset finished
LD HomeSeq6
OR Home_Error
OUT TR0
RSET Control_Mode
RSET Speed_Run_Fwd
RSET Speed_Run_Rev
ANDNOT Home_Error
SET Home_OK
LD TR0
RSET Home_Request
MOV(21) &00 HomeSequence
```

Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
01	April 2004	Initial version
02	March 2005	G7C supported

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