

Altivar ATV-IMC Drive Controller

VW3A3521S0 Hardware Guide

01/2010



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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Table of Contents



	Safety Information	5
	About the Book	7
Chapter 1	About the ATV-IMC	9
	About IMC	10
Chapter 2	Installation	15
	Installation and Maintenance Requirements	16
	First Startup	19
	Internal Battery	20
	Mounting the Card in the Drive	21
	Configurations Switches	24
Chapter 3	Wiring	27
	Terminals of the Card	28
	DC Power Supply Wiring and Characteristics	29
	I/O Wiring and Characteristics	30
Chapter 4	Connecting to a PC	35
	Connecting the IMC Card to a PC	36
Chapter 5	Communication Connections	39
	Ethernet Connection	40
	CANopen [®] Connection	42
Chapter 6	Configuration Using ATV Display	45
	First Start Configuration	46
	Card Changed / Removed	50
Chapter 7	ATV-IMC Operations	51
	Diagnostic	52
	ATV-IMC Drive Controller	56
	Warm / Cold Start	60
	Inputs Management	61
	Outputs Management	62
	Tasks Management	63
	Freewheeling Task	64
	Cyclic Task	66
	Event Task	68

	Watchdog Mechanisms70
Chapter 8	Fast Inputs71
	HSC Modes72
	HSC Simple Mode74
	HSC Main Modes75
Chapter 9	ATV-IMC Performances77
	Performances78

Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

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

WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury or equipment damage.

 CAUTION
--

CAUTION indicates a potentially hazardous situation, which, if not avoided, can result in injury or equipment damage.

CAUTION

CAUTION , used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, can result in equipment damage.
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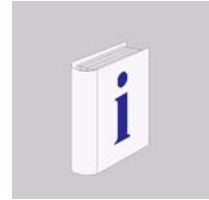
PLEASE NOTE

The word "drive" as used in this manual refers to the controller portion of the adjustable speed drive as defined by NEC.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this product.

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About the Book



At a Glance

Document Scope

The purpose of this document is to:

- show you how to install and operate your Integrated Machine Controller,
- show you how to connect the card to a programming device equipped with SoMachine software,
- help you understand how to interface the card with I/O modules and other devices,
- help you become familiar with the card features.

NOTE: Read and understand this document and all related documents (see below) before installing, operating, or maintaining your IMC.

The new users should read through the entire document to understand all features.

Validity Note

This documentation is valid for the Integrated Machine Controller.

Related Documents

Title of Documentation	Reference Number
ATV-IMC programming manual	EIO0000000390
Altivar 71 - Installation manual	1755855
Altivar 71 - Programming manual	1755843

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

About the ATV-IMC



1

What in this Chapter ?

This chapter contains the following topics:

Topic	Page
About IMC	10

About IMC

Introduction

The Drive Controller (ATV-IMC: Integrated Machine Controller) is used to adapt the variable speed drive to specific applications by integrating control system functions.

Various predefined configurable applications are sold by Schneider Electric and its partners. SoMachine is a professional, efficient and open OEM software solution that develops, configures and commissions the entire machine in a single environment (including logic, motor control, HMI and related network automation functions).

SoMachine allows you to program and commission the entire range of elements in Schneider Electric's Flexible Machine Control that helps you to achieve an optimized control solution for each machine's requirements.

Only one ATV-IMC programmable card can be installed in the Altivar 61 or the Altivar 71 drive. It can be combined with another option card (I/O extension or communication). ATV-IMC option card can not be used in combination with an ATV-IMC option card.

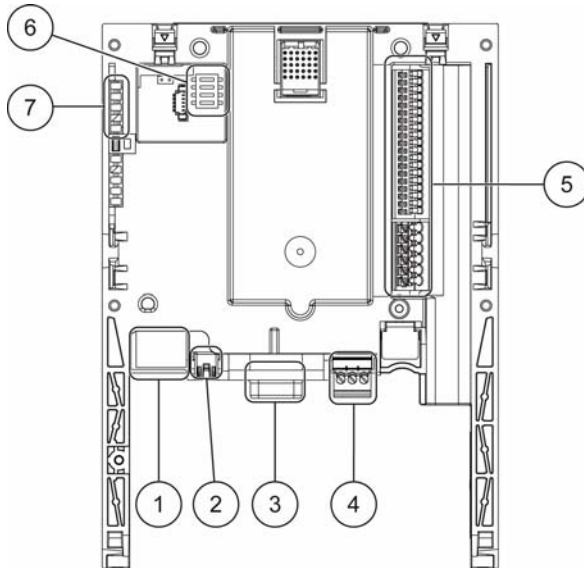
The ATV-IMC programmable card has:

- 10 logic inputs
- 2 analog inputs
- 6 logic outputs
- 2 analog outputs
- A master port for the CANopen® bus
- A mini-USB B port for programming with SoMachine software
- An Ethernet port to be used for programming with SoMachine software or ModbusTCP communication.

The ATV-IMC programmable card can also use:

- The drive I/O
- The I/O extension card (I/O basic and I/O extended)
- The encoder interface card points counter
- The drive parameters (speed, current, torque, etc)
- The drive remote keypad (as application HMI).

Physical Description



- 1 Ethernet port used for programming with SoMachine and for Modbus TCP communication.
- 2 mini-USB B port used for programming with SoMachine.
- 3 9-pin male SUB-D connector for connection to the CANopen[®] bus.
- 4 Connector with removable screw terminals, 3 contacts intervals of 3.81 mm (0.15 in.) for the 24 Vdc power supply.
- 5 10 logic inputs, 6 logic outputs, 2 analog inputs, 2 analog outputs and 5 commons.
- 6 Block of 4 configuration switches.
- 7 5 LEDs, comprising:
 - 1 LED G/Y **ETH** (EtherNet activity)
 - 1 LED G/R **NS** (Network Status)
 - 1 LED G/R **MS** (Module Status)
 - 1 LED G/R **CAN** (CANopen[®])
 - 1 LED G/R **USER** programmable from the customer

ATV-IMC Drive Controller Range

Power	Voltage	24 (min. 19, max. 30)	Vdc
Current consumption	Maximum	2	A
	No-load	80	mA
	Using logic output	200 maximum (1)	mA
Internal battery	Life	12	Years

(1) If the logic output power consumption does not exceed 200 mA, this card can be powered by the drive. Otherwise, an external 24 Vdc power supply must be used and must be able to provide 2 A.

Compiled program (saved in "flash" memory)	Maximum size	Mbytes	2
Data	Maximum size	Mbytes	1
	Saved size (NVRAM)	Kbytes	64
	Size accessible by Modbus	Word	60000

Associated Drive Reference

Altivar 61 or Altivar 71

SoMachine

In order to program the ATV-IMC card SoMachine software tool is required (programming cable: TCS XCN AM UM 3P).

The software tool can be connected to the ATV-IMC by mini-USB cable (Mini-B cable) or by Ethernet cable (490NTW000- cable). In factory settings mode, the ATV-IMC card only contains the clock function.

For other applications, the program must be loaded:

- By loading an existing program
- Or by loading a custom-built program, with the aid of the SoMachine software, using the function libraries dedicated to programming the ATV-IMC card.

The standard function library contains:

- Logic functions (AND, OR, etc)
- Mathematical functions (Cos, Sin, Exp, etc)
- Functions dedicated to drives which simplify data exchanges between the drive and the ATV-IMC programmable card (example: sending the speed reference)
- Functions for managing the CANopen[®] bus
- Graphic terminal display functions.

This manual does not describe programming using SoMachine, see ATV-IMC programming manual on www.schneider-electric.com.

Communication Features

3 kinds of ports existing, which are:

- Ethernet port
- CANopen port
- USB port.

Fast I/O Functions (HSC)

See Fast Inputs chapter.

Installation



2

What in this Chapter ?

This chapter contains the following topics:

Topic	Page
Installation and Maintenance Requirements	16
First Startup	19
Internal Battery	20
Mounting the Card in the Drive	21
Configurations Switches	24

Installation and Maintenance Requirements

Before Starting

Read and understand these instructions before performing any procedure with the drive

 WARNING
UNEXPECTED EQUIPMENT OPERATION <ul style="list-style-type: none">• Read and understand this manual before installing or operating the drive.• Any changes made to the parameter settings must be performed by qualified personnel. <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p>

Disconnect Drive Power

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Read and understand this manual before installing or operating the drive. Installation, adjustment, repair, and maintenance must be performed by qualified personnel.
- The user is responsible for compliance with all international and national electrical code requirements with respect to grounding of all equipment.
- Many parts of this drive, including the printed circuit boards, operate at the line voltage. DO NOT TOUCH. Use only electrically insulated tools.
- DO NOT touch unshielded components or terminal strip screw connections with voltage present.
- DO NOT short across terminals PA/+ and PC/- or across the DC bus capacitors.
- Before servicing the drive:
 - Disconnect all power, including external control power that may be present.
 - Place a “DO NOT TURN ON” label on all power disconnects.
 - Lock all power disconnects in the open position.
 - WAIT 15 MINUTES to allow the DC bus capacitors to discharge.
 - Measure the voltage of the DC bus between the PA/+ and PC/- terminals to ensure that the voltage is less than 42 Vdc.
 - If the DC bus capacitors do not discharge completely, contact your local Schneider Electric representative. Do not repair or operate the drive.
- Install and close all covers before applying power or starting and stopping the drive.

Failure to follow these instructions will result in death or serious injury.

Note: The DC bus voltage can exceed 1000 Vdc. Use a properly rated voltage-sensing device when performing this procedure. To measure the DC bus voltage

Operating Environment

WARNING

DAMAGED DRIVE EQUIPMENT

Do not operate or install any drive or drive accessory that appears damaged.

Failure to follow these instructions can result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must
 - consider the potential failure modes of control paths and, for certain critical control functions,
 - provide a means to achieve a safe state during and after a path failure.Examples of critical control functions are emergency stop and overtravel stop.
- Separate or redundant control paths must be provided for critical control functions.
- Each implementation of a control system must be individually and thoroughly tested for proper operation before being placed into service.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link (1)

Failure to follow these instructions can result in death or serious injury.

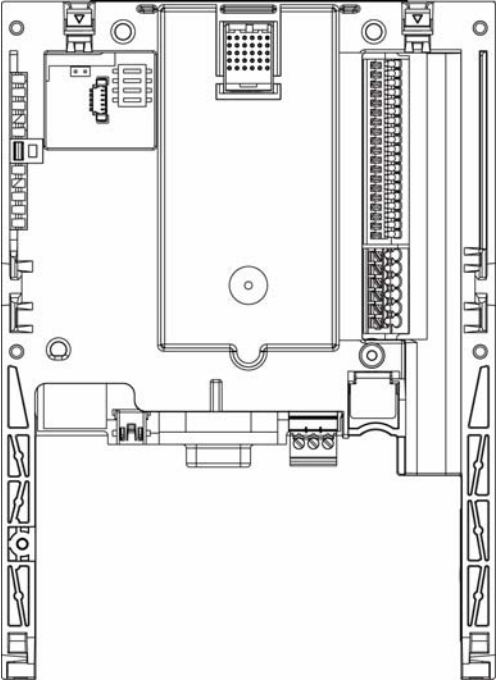
(1) : For additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control.

First Startup

Introduction

This procedure will help you through the first installation and start up of your device.

Startup Procedure

Step	Action	Comment
1	Check that the card catalog number marked on the label is the same as on the delivery note corresponding to the purchase order	
2	Remove the option card from its packaging and check that it has not been damaged in transit	
3	Check that the product is complete: the packaging should contain the ATV-IMC option card and a removable terminal	
4	Please, follow the procedure described on Mounting Procedure (page 21) to mount the card in the drive	

Internal Battery

Introduction

In the event of a power outage, the internal battery will retain the internal clock.

Internal Battery

A clock backed up by a lithium battery makes it possible to have a log of events that have occurred.

When the ATV-IMC programmable card is installed in the drive, events can be time and date-stamped, see programming manual.

The date and time need to be set on receipt of the Integrated Machine Controller card, or after replacing its lithium battery.

When connected to the configuration software tool (SoMachine) the ATV-IMC clock can be synchronized with the PC clock.

The date and time on this clock are checked and set from a special sub-menu in the [\[1.14 - C Inside\] \(PLC\)](#) customizable menu in the graphic display terminal.

DANGER

EXPLOSION, FIRE, OR CHEMICAL HAZARD

Follow these instructions for the Lithium batteries:

- Do not recharge, disassemble, heat above 100 °C (212 °F), or incinerate.
- Contact Schneider Electric support to replace the internal battery.

Failure to follow these instructions will result in death or serious injury.

Mounting the Card in the Drive

Mounting Procedure

Note: If an ATV-IMC card and an I/O extension card are installed simultaneously:

- The I/O extension card must be installed on the drive first
- Then the ATV-IMC must be installed on the I/O extension card.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Read and understand this manual before installing or operating the drive. Installation, adjustment, repair, and maintenance must be performed by qualified personnel.
- The user is responsible for compliance with all international and national electrical code requirements with respect to grounding of all equipment.
- Many parts of this drive, including the printed circuit boards, operate at the line voltage. **DO NOT TOUCH.** Use only electrically insulated tools.
- **DO NOT** touch unshielded components or terminal strip screw connections with voltage present.
- **DO NOT** short across terminals PA/+ and PC/- or across the DC bus capacitors.
- Before servicing the drive:
 - Disconnect all power, including external control power that may be present.
 - Place a "DO NOT TURN ON" label on all power disconnects.
 - Lock all power disconnects in the open position.
 - **WAIT 15 MINUTES** to allow the DC bus capacitors to discharge.
 - Measure the voltage of the DC bus between the PA/+ and PC/- terminals to ensure that the voltage is less than 42 Vdc.
 - If the DC bus capacitors do not discharge completely, contact your local Schneider Electric representative. Do not repair or operate the drive.
- Install and close all covers before applying power or starting and stopping the drive.


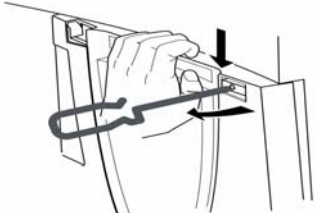
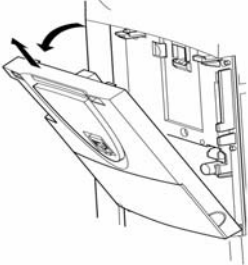
Failure to follow these instructions will result in death or serious injury.

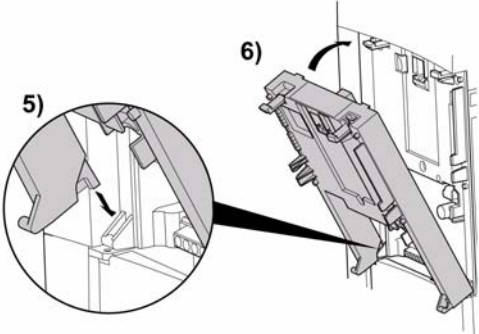
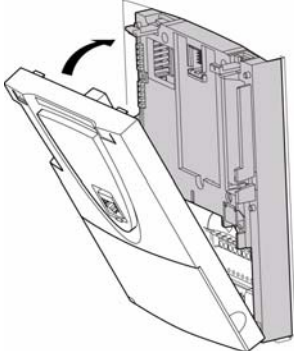
CAUTION

RISK OF DAMAGE TO THE ATV-IMC

Prior to using it, the ATV-IMC must be plugged into ATV61 or ATV71.

Failure to follow these instructions can result in equipment damage.

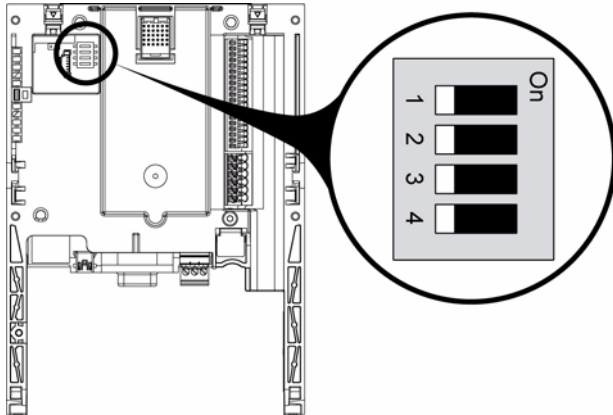
Step	Action	Comment
1	Disconnect drive power	-
2	Using a screwdriver, press down on the catch and pull to release the left-hand part of the control front panel of the drive	
3	Do the same on the right-hand side	
4	Pivot the control front panel and remove it	
5	Install the I/O extension card, if used	Refer to the I/O extension card instruction sheet

Step	Action	Comment
6	Position the card on the clasps	
7	Then pivot it until it clicks into place	
8	Replace the control front panel over the card (same procedure as for installing the option card, see 5 and 6)	

Configurations Switches

Introduction

The ATV-IMC card has a block of 4 switches as illustrated below:



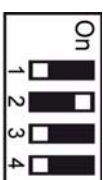
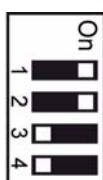
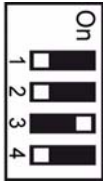

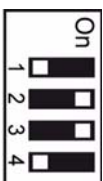
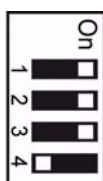



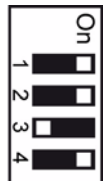

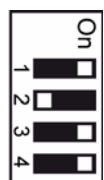

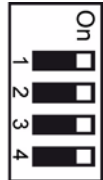


These switches can only be set when the drive and the ATV-IMC card are turned off, since it is necessary to remove the drive control front panel in order to access it.

By default, the switches are in the Off position.

Programmable Switches

The 4 switches can be used by the ATV-IMC card program, depending on the application.

Switches	Value	Switches	Value	Switches	Value	Switches	Value
	0		1		2		3
	4		5		6		7
	8		9		10		11
	12		13		14		15

To read these switches, see function block (Get_Dipswitch) in the on-line help of library ATV_IMC_SysLib_V2_3.

Wiring



3

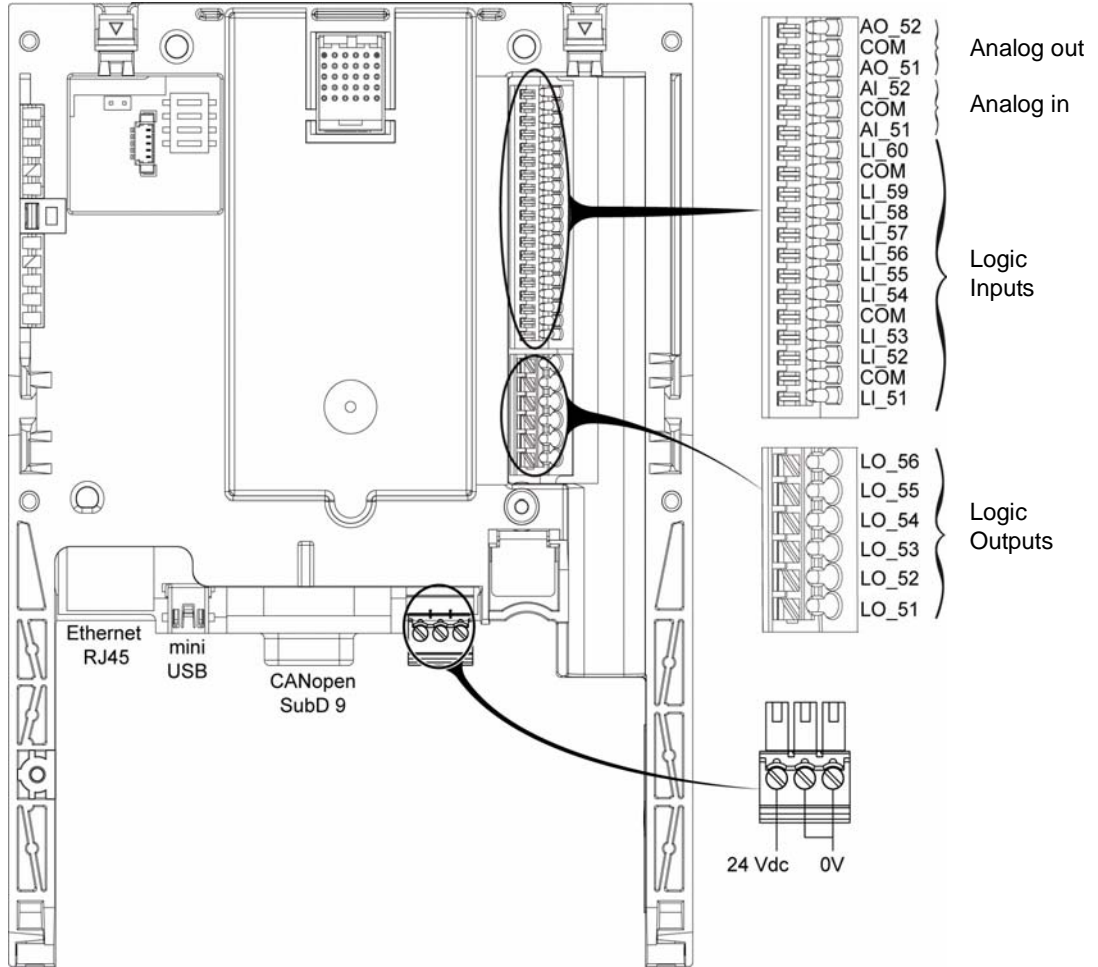
What in this Chapter ?

This chapter contains the following topics:

Topic	Page
Terminals of the Card	28
DC Power Supply Wiring and Characteristics	29
I/O Wiring and Characteristics	30

Terminals of the Card

The following figures describes the different terminals of the card:



DC Power Supply Wiring and Characteristics

24 Vdc Terminal

Power supply for the ATV-IMC card, logic outputs and analog outputs.

If allowed by the power consumption table (for example if outputs are not being used), the ATV-IMC card can be powered by the 24 Vdc power supply in the drive.

If you are using an external power supply: Catalog number for a Schneider Electric power supply ABL8REM24030 (24Vdc, 3A).

COM Terminal

Common ground and electrical 0 V of the ATV-IMC card power supply, logic inputs, (L●●), outputs (LO●●), analog inputs (AI●●) and analog outputs (AO●●).

This ground and electrical 0 V are common with the drive ground and electrical 0 V. There is therefore no point in connecting this terminal to the 0 V terminal on the drive control terminals.

I/O Wiring and Characteristics

Ground Shielded Cable Connection

In order to maintain a high level of resistance to electromagnetic interference, the use of shielded cables is required for Fast inputs.

To improve Electromagnetic Compatibility (EMC), use shielded cables for all inputs and outputs.

 WARNING
UNEXPECTED EQUIPMENT OPERATION <ul style="list-style-type: none">• Connect all fast inputs with shielded cables.• Properly ground the cable shields as indicated in this documentation. Failure to follow these instructions can result in death, serious injury, or equipment damage.

I/O Characteristics

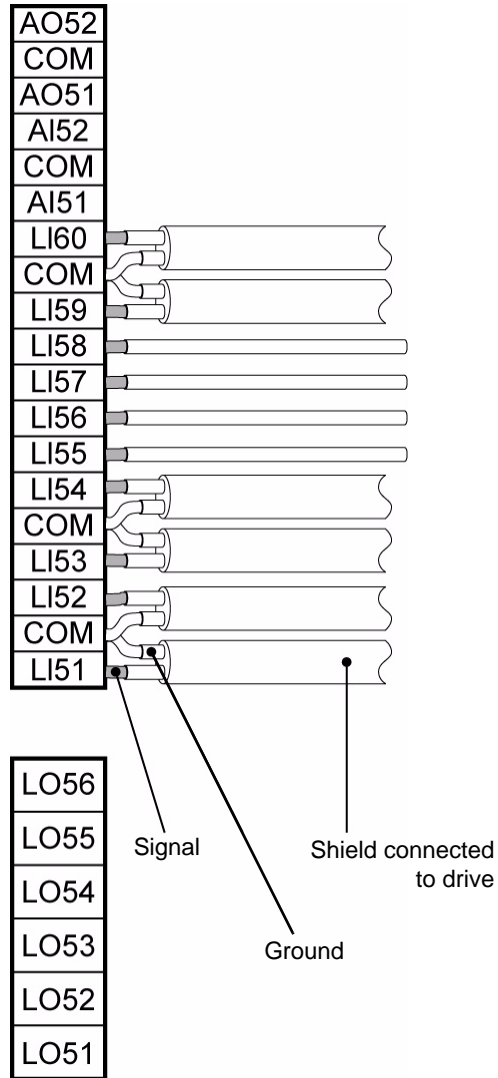
The following table describes the characteristics of the I/O:

Analog inputs	AI51, AI52	<ul style="list-style-type: none"> - 2 current analog inputs 0...20 mA. Connect an impedance 250 Ω - Or 2 voltage analog inputs 0...5 V Resolution: 10 bits. Current and voltage configurable by library. Accuracy: $\pm 1\%$ for a temperature variation of 60°C (140°F) Linearity: $\pm 0.4\%$ of the maximum value Common point for the card I/O (1)
Analog outputs	AO51, AO52	2 current analog outputs 0...20 mA, impedance 500 Ω Resolution: 10 bits Accuracy: $\pm 1\%$ for a temperature variation of 60°C (140°F) Linearity: $\pm 0.2\%$ of the maximum value Common point for the card I/O (1)
Logic inputs	LI51...LI60	10 24 Vdc logic inputs: <ul style="list-style-type: none"> - Inputs LI51 and LI59 can be configured as single phase counter. - Inputs LI51 and LI52 can be configured for an incremental encoder (channel A = LI51, channel B = LI52). - Inputs LI59 and LI60 can be configured for an incremental encoder (channel A = LI59, channel B = LI60). Maximum voltage: 30 Vdc. Impedance 4.4 k Ω Switching thresholds: <ul style="list-style-type: none"> - State 0 if ≤ 5 V or logic input not wired - State 1 if ≥ 11 V Common point for the card I/O (1)
Logic outputs	LO51...LO56	Six 24 Vdc logic outputs, positive logic, compatible with level 1 PLC, standard IEC 65A-68 Maximum switching voltage: 30 V Maximum current: 200 mA maximum for logic outputs without external +24Vdc power supply. With +24Vdc power supply, the maximum is 200mA for each logic output. Common point for the card I/O (1)
I/O connection	Type of contact	Screw, at intervals of 3.81 mm (0.15 in.)
	Maximum wire	1.5 mm ² (16 AWG)
	Tightening torque	0.25 Nm (2.21 lb-in)

(1) This common point is also the drive 0 V (COM).

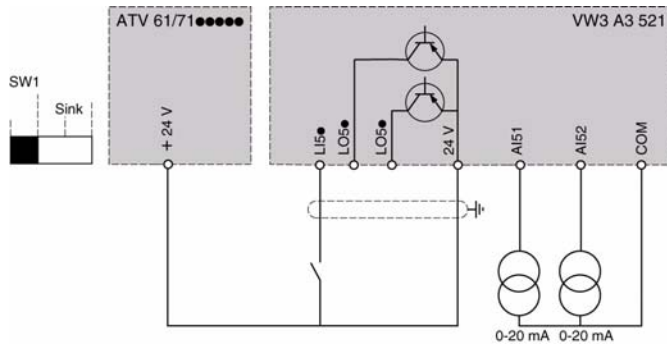
Logic inputs LI51...LI60 wiring

The following graphic describes the shielded twisted pair:

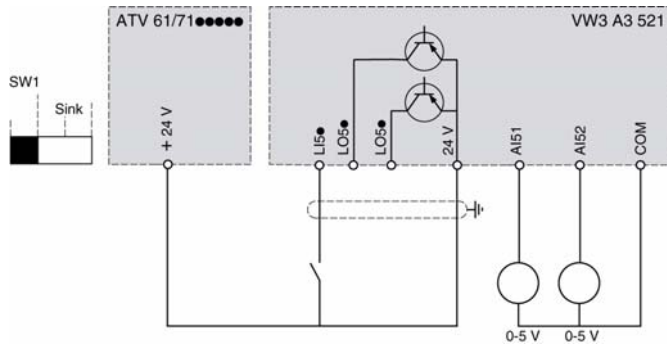


I/O Wiring Diagram

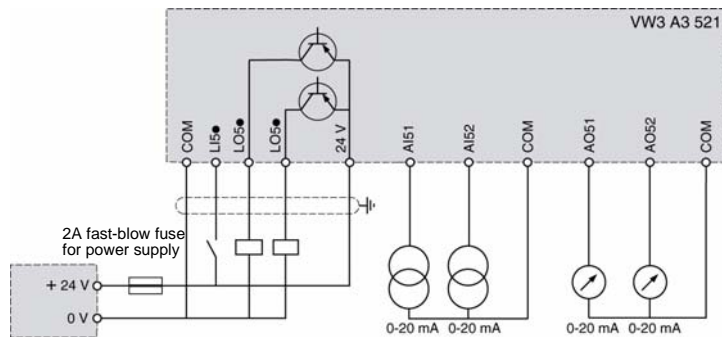
Only if the power consumption is less than 200 mA; otherwise use an external power supply. When drive power supply is used and the logical output consumption exceeds 200 mA the card will cut out the logical output.



Current diagram



Voltage diagram



Card powered by external power supply

Connecting to a PC



4

What in this Chapter ?

This chapter contains the following topics:

Topic	Page
Connecting the IMC Card to a PC	36

Connecting the IMC Card to a PC

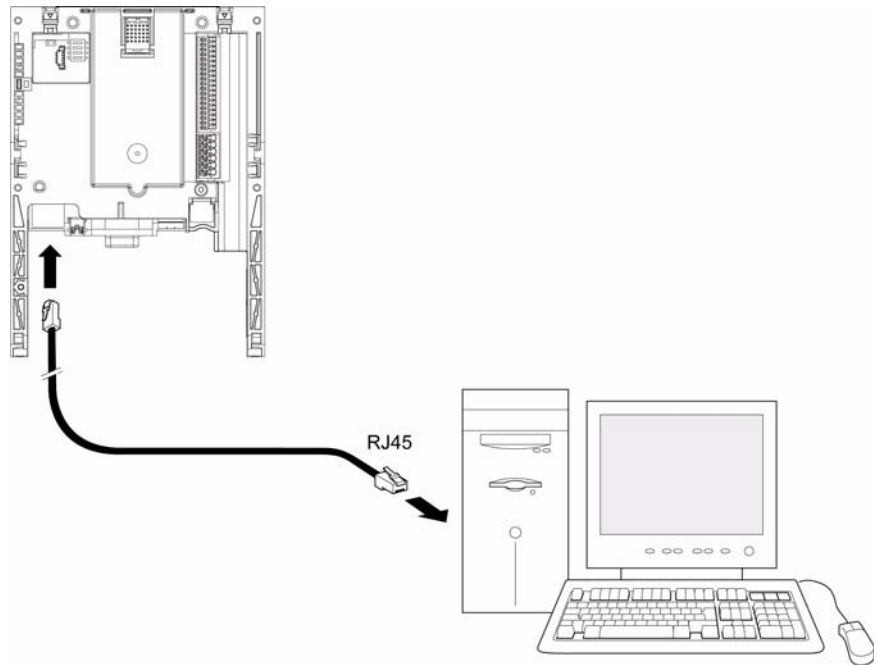
Introduction

The ATV-IMC card can be connected to the PC using two different ways, by Ethernet connection or by mini-USB cable.

The default IP address for the card is derived from its hardware MAC address.

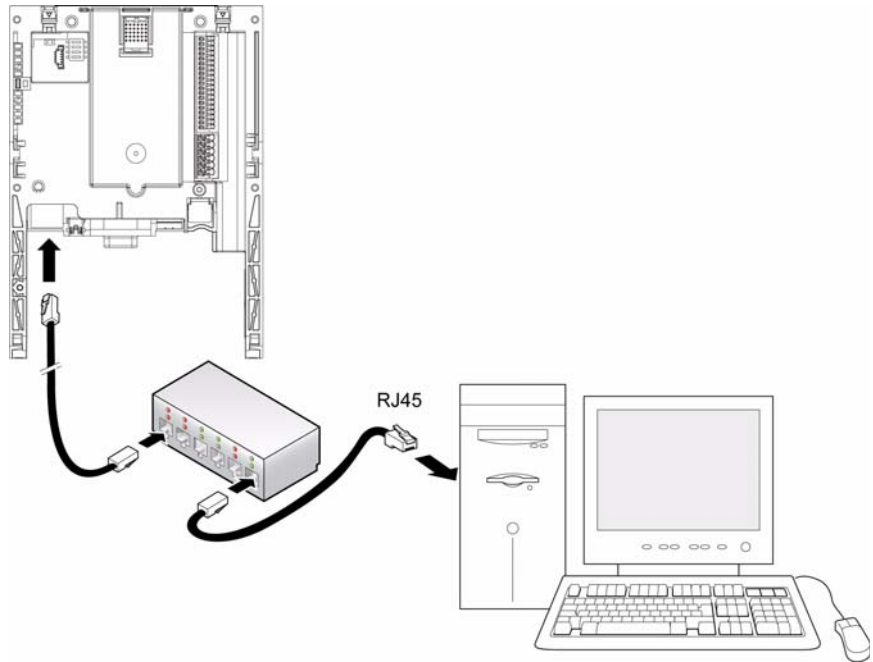
Connecting Through Ethernet

The following drawing describes the Ethernet connection:



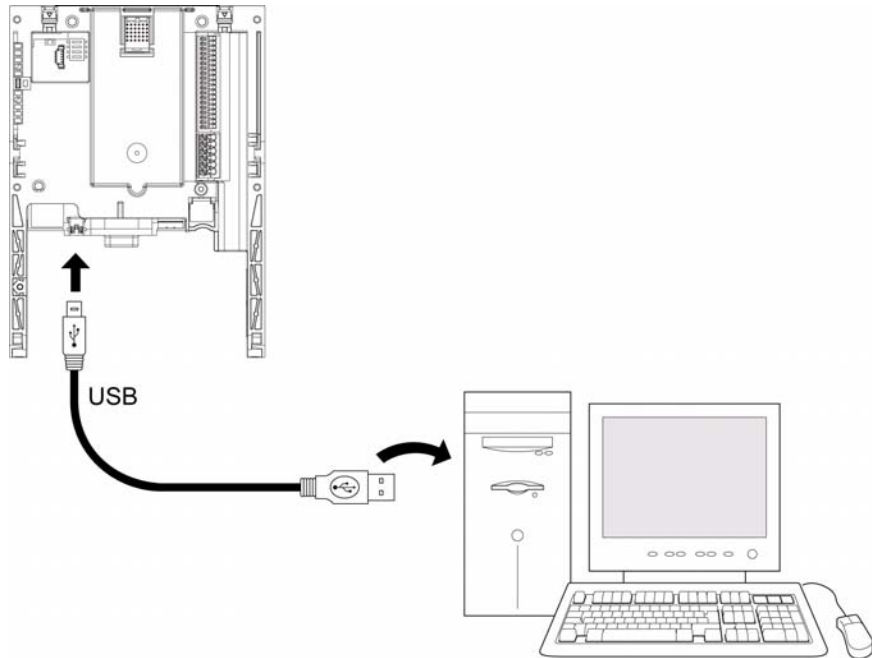
For more information about Ethernet, please read Ethernet Connection page 40.

The following drawing describes the Ethernet connection with a HUB:



Connecting Through USB

The following drawing describes the Mini USB connection:



CAUTION

RISK OF EQUIPMENT DAMAGE

- In case of high power drive, the PC must be disconnected from the ground
- Ensure ground connection between the drive and motor to avoid communication perturbation with the USB link.

Failure to follow these instructions can result in equipment damage.

Note: High Power Drive références are ATV71H•••N4 or ATV61H•••N4 ≥ 90 kW (125HP) and ATV71H•••Y or ATV61H•••Y ≥ 110 kW (150HP).

Communication Connections

5

What in this Chapter ?

This chapter contains the following topics:

Topic	Page
Ethernet Connection	40
CANopen [®] Connection	42

Ethernet Connection

Ethernet Capabilities

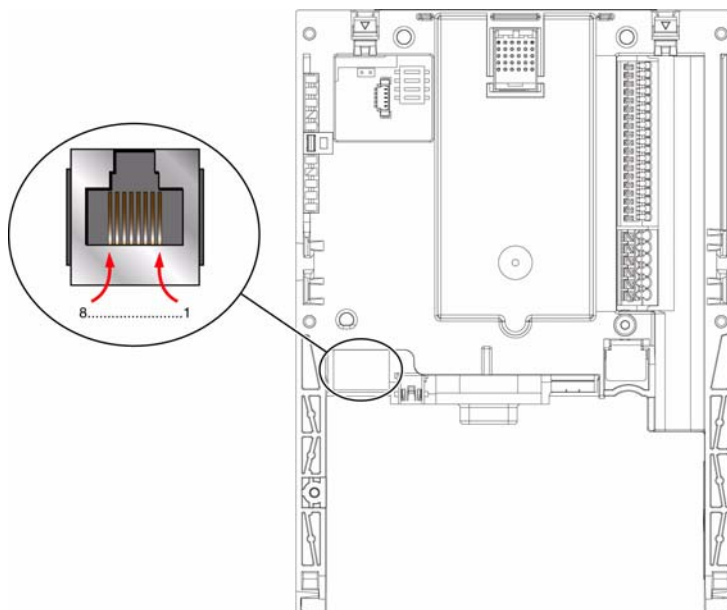
In order to be able to communicate via Ethernet, the ATV-IMC card includes, as standard, a link.

This port allows to communicate according to 2 protocols:

- Programming, for link with a PC (equipped with SoMachine Software).
- TCP/Modbus, in order to meet the needs of master/slave architectures with Schneider Electric or third party devices.

Ethernet Connector Diagram

Pin	Description
1	TD+
2	TD-
3	RD+
4	-
5	-
6	RD-
7	-
8	-



- Address Format

IP address by default is 0.0.0.0 used as 10.10.x.x:

10.10: a fixed value

x: The last two fields in the default IP address are composed of the decimal.

equivalents of the last two hexadecimal bytes in the MAC address of the card. The MAC address of the card can be retrieved on the card label placed on the internal right side of the card.

The Default Subnet Mask must be the Default Class A Subnet Mask of 255.0.0.0.

- Example

For example, with the MAC address of 00-80-F4-DA-01-C4, you are concerned only with the last two bytes, 01-C4. Convert these bytes from hexadecimal to decimal. See the procedure below if you don't know how to do this.

The hexadecimal values 01, and C4 have corresponding decimal values of 1, and 196, respectively.

These values are combined with the default IP address format (85.16.x.x) to yield a default IP address of 10.10.1.196.

CANopen[®] Connection

CANopen[®] Capabilities

Structure	Connector	One 9-pin male SUB-D connector
	Network management	Master 10
	Transmission speed	Configurable via the program: 20 kbps, 50 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps, 1 Mbps
	Address (Node ID)	16 slaves maximum
Services	CANopen [®] application layer	DS 301 V4.02
	Channel config	DSP 405
	PDO	32 PDOs Tx, 32 PDOs Rx
	SDO	2 client SDOs per slave (1 read and 1 write). Block transfer
	Error check	Node Guarding, producer and consumer Heartbeat
	Other services	Emergency, Boot-up, Sync
	Configuration	The CANopen [®] network configurator is integrated in the SoMachine software workshop
Diagnostics	Using LED	1 LED: "RUN" / "ERROR", conforming to CIA [®] DR303 version 1.0

CANopen[®] Connector Diagram

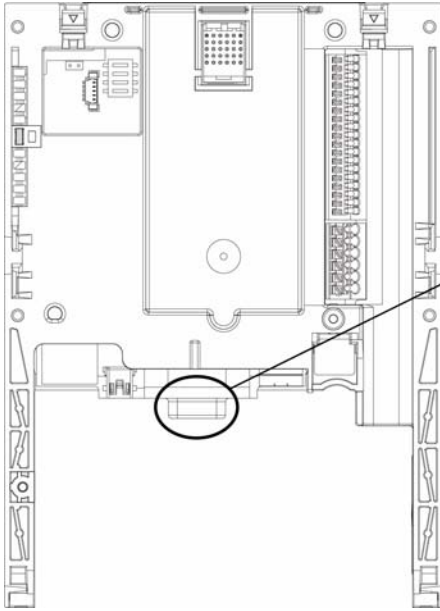
Use a straight connector (catalog number TSX CAN KCDF 180T) to connect the ATV-IMC card to the CANopen[®] bus.

This connector integrates a line terminator that must be activated if the ATV-IMC card is at one end of the CANopen[®] bus.

It is not possible to use an angled connector because of the terminals located to the right of the CANopen[®] connector.

The 9-pin SUB-D connector on the ATV-IMC card is linked to the card ground and

the drive ground. The shielding must be connected to the connector ground.
The CANopen[®] signals on the ATV-IMC card are isolated.



Pin	Description
1	not connected
2	CAN_L
3	CAN_GND
4	not connected
5	not connected
6	CAN_GND
7	CAN_H
8	not connected
9	not connected

Cable Length

It is essential to make sure that all devices connected to the CANopen[®] bus operate at the same transmission speed.

The CANopen[®] transmission speed of the ATV-IMC card is configured from the SoMachine software workshop.

The maximum length of the CANopen[®] bus depends on the transmission speed on this bus.

The table below indicates the maximum lengths permitted according to the transmission speed:

Transmission speed	20 kbps	50 kbps	125 kbps	250 kbps	500 kbps	800 kbps	1 Mbps
Max. length of bus	2500 m (8202 ft)	1000 m (3280 ft)	500 m (1640 ft)	200 m (656 ft)	100 m (328 ft)	40 m (131 ft)	5 m (16 ft)

Configuration Using ATV Display



6

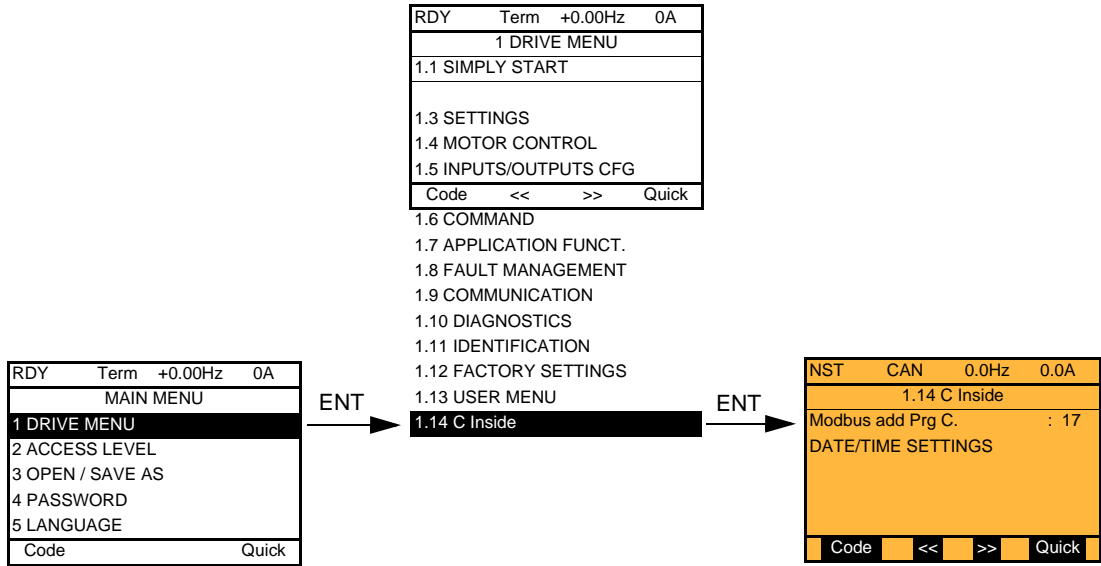
What in this Chapter ?

This chapter contains the following topics:

Topic	Page
First Start Configuration	46
Card Changed / Removed	50

First Start Configuration

A Menu



ATV-IMC Card Modbus Address

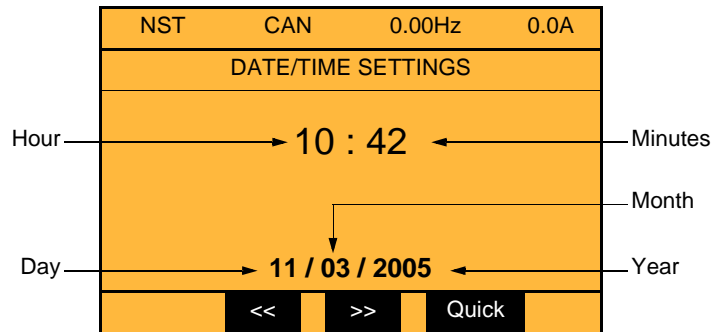
The [Modbus add Prg C.] (AMOA) parameter can be set in the [1.14 C Inside] (PLC) menu.

This setting can also be accessed in the [1.9 - COMMUNICATION] (COM-) menu, [MODBUS NETWORK] (Md1-) submenu.

Setting the date and time

In the [1.14 C Inside] menu, [DATE/TIME SETTINGS] sub-menu, you can set:

- the year
- the month
- the day
- the hours
- the minutes



Note: The date and time are not refreshed on this settings screen. The current date and time [Date/Time] (CLD) can be viewed in the [1.2 MONITORING] (SUP-) menu.

Note: It is not possible to change either the date or time format:

- The date cannot be displayed in the "year/month/day" format.
- The time cannot be displayed in the "10:42 am" format.

Note: It is not possible to configure changes between winter and summer hours.

Example of a Special Program

The name of menu 1.14 has been customized.

The application parameters are edited in plain text.

CYCLE IN PROGRESS	
Current cycle	: 5
Current phase	: 2
Operation	: dosing
Product	: oil
Duration	: 30 s
SETTINGS	
Cycle selected	: 10
No. of phases	: 6
Phase selected	: 2
Operation sel	: mixing

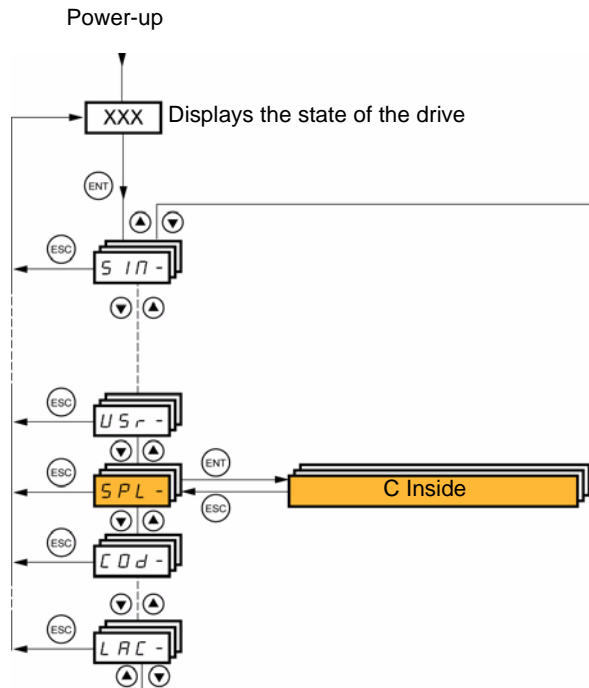
RUN	APP	+50.0 Hz	2.1 A
1.14 DOSING			<input type="checkbox"/>
CYCLE IN PROGRESS			
Current cycle			: 5
Current phase			: 2
Operation			: dosing
Product			: oil ▼
		<<	>>
		Quick	

CYCLE IN PROGRESS	
Current cycle	: 5
Current phase	: 2
Operation	: dosing
Product	: oil
Duration	: 30 s
SETTINGS	
Cycle selected	: 10
No. of phases	: 6
Phase selected	: 2
Operation sel	: mixing

RUN	APP	+50.0 Hz	2.1 A
1.14 DOSING			▲
SETTINGS			
Cycle selected			: 10
No. of phases			: 6
Phase selected			: 2
Operation sel			: mixing ▼
		<<	>>
		Quick	

ATV-IMC Menu of the Drive

From the drive display terminal is possible to access a dedicated programmable card submenu:



Card Changed / Removed

Option Card Changed or Removed

When an option card is removed or replaced by another, the drive locks in [\[Incorrect config.\] \(CFF\)](#) mode on power-up.

If the card has been deliberately changed or removed, this can be cleared by pressing the ENT key twice, which **causes the factory settings to be restored** for the parameter groups affected by the card.

These are as follows:

- **ATV-IMC card replaced by a card of the same type:** [\[1.14 - C Inside\] \(PLC\)](#)
- **ATV-IMC card removed** (or replaced by a different type of card): [\[Drive menu\] \(drM\)](#) and [\[1.14 - C Inside\] \(PLC\)](#).

ATV-IMC Card Modbus Address

WARNING

UNEXPECTED EQUIPMENT OPERATION

- Be sure that there is only one master controller configured on the network or remote link.
- Be sure that all slaves devices have unique addresses such that two or more slaves do not have the same address.

Failure to follow these instructions can result in death or serious injury.

ATV-IMC Operations



7

What in this Chapter ?

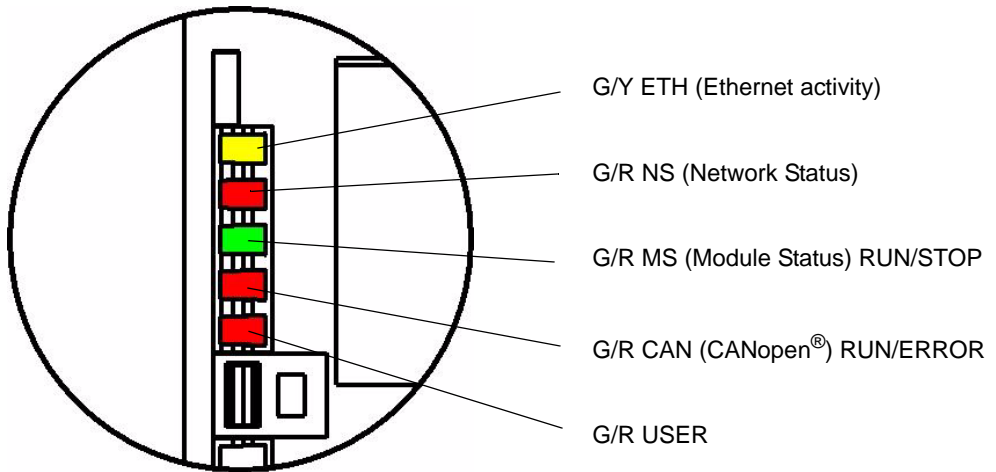
This chapter contains the following topics:

Topic	Page
Diagnostic	52
ATV-IMC Drive Controller	56
Warm / Cold Start	60
Inputs Management	61
Outputs Management	62
Tasks Management	63
Freewheeling Task	64
Cyclic Task	66
Event Task	68
Watchdog Mechanisms	70

Diagnostic

LED

The ATV-IMC card is equipped with five LEDs which can be seen through the window in the Altivar cover.



Led	State	Meaning
G/Y ETH	Off	No link
	Flashing Green/ yellow	Power up testing. Power up testing. Flashing 3 times
	Green On	Link at 100 Mbps
	Yellow On	Link at 10 Mbps
	Green flash	Activity at 100 Mbps
	Yellow flash	Activity at 10 Mbps

Led	State	Meaning
G/R NS	Off	The device does not have an IP address or powered off
	Flashing Green/ red	Power up testing. Flashing 3 times
	Green On	The device has at least one established connection (even to the Message Router)
	Green flashing	The device has not established connections, but has obtained an IP address
	Red flashing	One or more of the connections in which this device is the target has timed out. This LED will remain flashing until all time out connections are reestablished or if the device is reset
	Red On	The device has detected that its IP address is already in use
G/R MS RUN/STOP	Off	No power is supplied to the device
	Flashing Green/ red	Power Up testing. Flashing 3 times
	Green On	The device is operating correctly
	Green flashing	The device has not been configured
	Red flashing	The device has detected a recoverable event
	Red On	The device has detected a non-recoverable event
G/R CAN RUN/ERROR	CANopen [®] RUN / green off	CANopen [®] master in STOPPED state
	CANopen [®] RUN / flashing	CANopen [®] master in PRE-OPERATIONAL state
	CANopen [®] RUN / on	CANopen [®] master in OPERATIONAL state
	CANopen [®] ERROR / 1 flash per second	The CANopen [®] master error counter has reached or exceeded its warning level (too many detected errors)
	CANopen [®] ERROR / 2 flashes per second	Node Guarding error (vis-à-vis a CANopen [®] slave) or Heartbeat error (CANopen [®] master acting as consumer)
	CANopen [®] ERROR / on	The CANopen [®] master is in the "OFF" state
G/R USER	Defined by the user	-

ATV Display

The values of the ATV-IMC card logic and analog I/O can be displayed on the graphic display terminal: [1.2 - MONITORING] (SUP-) menu, [Controller Inside I/O MAP] sub-menu.

RUN	Term	+50.00Hz	80A
Controller Inside I/O MAP			
C. INSIDE CARD LI MAP			
Controller inside AI MAP			
C. INSIDE CARD LO MAP			
Controller inside AO MAP			
Code	Quick		

Move from one screen to another (from C. INSIDE CARD LI MAP to Controller inside AO MAP) by turning the navigation button

state 0
state 1

RUN	Term	+50.00Hz	80A			
C. INSIDE CARD LI MAP						
LI51	LI52	LI53	LI54	LI55	LI56	LI57
LI58						
1						
0						
LI59	LI60					
1						
0						
<<			>>			Quick

RUN	Term	+50.00Hz	80A
Controller inside AI MAP			
AI51	:	0.000 mA	
AI52	:	9.87 V	
Code	<<	>>	Quick

ENT

RUN	Term	+50.00Hz	80A	
AI51				
0 mA				
Min = 0.001		Max = 20,000		
<<			>>	Quick

state 0
state 1

RUN	Term	+50.00Hz	80A			
C. INSIDE CARD LO MAP						
LO51	LO52	LO53	LO54	LO55	LO56	
1						
0						
<<			>>			Quick

RUN	Term	+50.00Hz	80A
Controller inside AO MAP			
AO51	:	0.000 mA	
AO52	:	9.87 V	
Code	<<	>>	Quick

ENT

RUN	Term	+50.00Hz	80A	
AO51				
0 mA				
Min = 0.001		Max = 20,000		
<<			>>	Quick

Note: The addresses of the parameters mentioned above are given in the "Communication parameters manual".

Event Monitoring

[internal com. link] (ILF) is displayed when:

- There is a detected hardware fault
- A communication interruption occurs between the ATV-IMC card and the drive

The drive behavior cannot be configured when [internal com. link] (ILF) is displayed. The drive performs a freewheel stop. This can only be reset by performing a power reset on the drive.

Two diagnostic parameters can be used to obtain more detailed information on the cause of [internal com. link] (ILF):

- [Internal link fault 1] (ILF1) indicates option card no. 1 (installed directly on the drive).
- [Internal link fault 2] (ILF2) indicates option card no. 2 (installed directly on the drive).

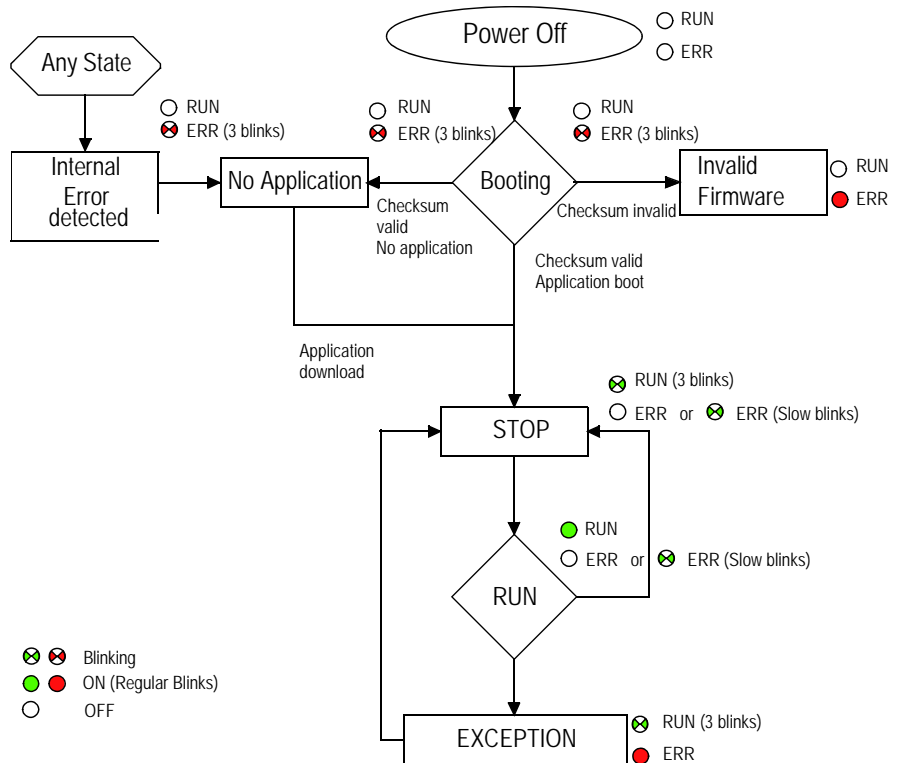
The ATV-IMC card can be in position 1 or in position 2.

Parameters [Internal link fault 1] (ILF1) and [Internal link fault 2] (ILF2) can only be accessed on the graphic display terminal, in the [1.10 DIAGNOSTICS] (DGT-), [MORE FAULT INFO] (AFI-) menu.

ATV-IMC Drive Controller

State Diagram

The following state diagram shows the controller states and transitions and the corresponding system LED states.



Booting

The ATV-IMC first executes the boot sequence. It performs a checksum of the firmware. If the checksum is valid, the controller can start. Otherwise, the ERR LED blinks to indicate that the firmware is invalid.

If the firmware is invalid, a firmware upgrade is required before the device can be used.

RUN

The ATV-IMC executes the application, updates the I/Os.

In this state:

- The RUN LED is ON
- The ERR LED is OFF or is blinking slowly if the boot application is not yet created

STOP

The program execution is stopped and:

- Internal variables are frozen in their current state.
- Output images are frozen in their current state.
- Embedded and/or expansion physical outputs can be either in Fallback state or in "Keep current value" state, according to the option you selected in the SoMachine software.
- HSC function blocks output values are frozen (The function blocks can no longer be invoked).
- Embedded inputs are refreshed into input images (only if "Update IOs while in stop" option is selected in SoMachine software).
- Expansion bus inputs are refreshed from the expansion modules into input images (only if "Update IOs while in stop" option is selected in SoMachine software).

In this state:

- The RUN LED blinks (500 ms ON, 500 ms OFF)
- The ERR LED is OFF or is blinking slowly if the boot application is not yet created

Note:

- Situation 1: "Update IOs while in stop" and "Set all outputs to default" selected.
The values defined in "Default value" column of I/O mapping screen is applied to the outputs. Any write to the output (via Modbus) is not applied to the physical output.
- Situation 2: "Update IOs while in stop" and "Keep current values" selected.
The outputs keep the last value set by the program when it was in RUN. Any write to the output (via Modbus) is not applied to the physical output.
- Situation 3: No "Update IOs while in stop".
The output keeps the last value set by the program when it was in RUN. Any write to the output (via Modbus) is not applied to the physical output.

No Application

Only an application download allows the ATV-IMC to resume booting.

In this state:

- The RUN LED is OFF
- The ERR LED blinks (500 ms ON, 500 ms OFF)

Internal Error

This state is reached from any state when an internal error (firmware exception, infinite loop) is detected. The STOP state conditions are applied automatically.

In this state, only 2 possible actions are allowed:

- Download new application
- Power off

In this state:

- The RUN LED is OFF
- The ERR LED blinks quickly

EXCEPTION

This state is reached if a watchdog event associated with a task is triggered, or when a system overload occurs. The STOP state conditions are applied.

When the controller is in Watchdog state, only 3 possible actions are allowed:

- Reset
- Download new application
- Power off

In this state:

- The RUN LED blinks
- The ERR LED is ON

HALT ON BREAKPOINT

The application is valid and running, but a task is stopped on a breakpoint, and:

- Outputs are frozen in their current state.
- Event tasks are processed, and I/Os are functional.

In this state:

- The RUN LED blinks slowly
- The ERR LED is OFF

Boot Application

A Boot Application is a backup copy of the application program that is stored in ATV-IMC flash memory. This allows persistent storage of an application program without the need for battery power.

A Boot Application is automatically saved to flash memory after download.

- 1 The ATV-IMC is shipped from the factory without any Boot Application in flash memory. Therefore, the controller state after first power ON is No Application.
- 2 Reset Origin erase a Boot Application.

Warm / Cold Start

Warm start: When power is removed from the controller, the current state of the retained data is stored in memory. The RETAIN keyword is to be used. At the next power on, the controller application restarts in RUN mode or STOP (depending on its state at Power OFF), and uses this stored data to return to its previous state.

Cold start: The controller tries to restart with the application that has been backed up to flash memory.

Note: If there is no application in flash memory, then the controller waits in "no application" state for a new download.

Inputs Management

Introduction

The following functions are configurable on the standard and fast inputs:

- The LI53 and LI54 inputs can be used for events (rising edge, falling edge, or both) and thus be linked to an event task (up to 2), see Tasks Management page 63.
- For other LI, see HSC Modes page 72.

Event Task

Refer to Event Task page 68.

RUN/STOP

The RUN/STOP function is used to start or stop a program using an input:

- When the configured RUN/STOP input is at logic 0, the controller is put into a STOP state and any SoMachine command to enter the RUN state is ignored.
- When the configured RUN/STOP input is at logic 1, then the controller program is running unless otherwise commanded by SoMachine (RUN/STOP commands from SoMachine are allowed).

Outputs Management

Introduction

The ATV-IMC has 6 standard outputs.

Output values can be controlled by the controller application or by using SoMachine in the Online mode.

Tasks Management

Introduction

The Task Configuration allows defining one or several tasks to control the execution of an application program.

Task Type

There are 3 different types of task available:

- Freewheeling: The task will be executed as soon as the program is started. As each task completes, the task will be automatically restarted in a continuous loop, after a delay that is 30%-proportional to the duration of the last task cycle. There is no cycle time defined but T#: 1...1000 ms.
- Cyclic: The task will be executed cyclically according to the period defined.
- External Event: The task will be started as soon as the associated variable (physical fast input) occurs.

Maximum Task Configuration

For the ATV-IMC, you can configure up to 9 tasks with the following restrictions:

- 1 Freewheeling task maximum,
- 3 Cyclic tasks maximum,
- 5 External tasks maximum.

When you add an ATV-IMC to your project, the SoMachine software creates a master task called MAST. The MAST task has a preset priority level of 15 (medium priority). The MAST task is created by default in Cyclic mode and its preset interval time is 20 ms. The watchdog service is activated by default with a time of 100 ms and a sensitivity of 1.

Watchdog

For each task a control timer (watchdog) can be configured.

The watchdog is configured using the SoMachine software. To configure the watchdog, you must define two parameters:

- Time
- Sensitivity

When the watchdog is activated, if the execution time is longer than defined in the Time field then the controller will be stopped and an error will be reported. In this case, the task is not finished.

The Sensitivity field defines the number of times a watchdog overrun can occur before a watchdog event is generated.

Note: If you set sensitivity to 0, the control is disabled as if the watchdog checkbox was not selected.

Freewheeling Task

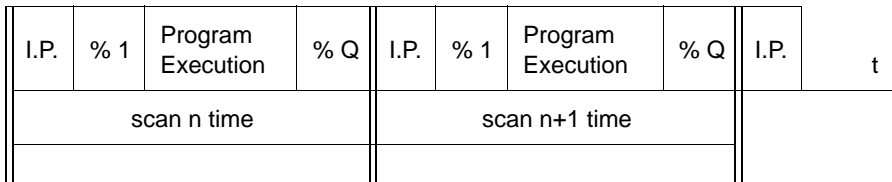
Introduction

The freewheeling scan time does not have a fixed duration. In freewheeling mode, each ATV-IMC scan begins when the previous scan has been completed successfully.

Note: If you configure a watchdog to monitor the performance of your application program, confirm that the watchdog time exceeds the normal scan time of the program. The scan time of each task must not exceed the configured watchdog value. Otherwise you may experience frequent watchdog events, with the result that the program enters the STOP mode unnecessarily, and that the outputs are forced to their fallback states.

Operation

The following diagram shows the operating phases of two consecutive scans:



Cycle Phases Description

	Phase	Description
I.P.	Internal Processing	The I.P. phase includes the internal processing, and a Idle duration. The global duration of I.P. phase is computed based on the duration of the last cycle: 30 % of this value. The I.P. phase cannot be shorter than 2 ms.
% 1	Inputs Acquisition	Writes the status of discrete and application-specific module inputs to the memory.
-	Program Execution	Runs the application program written by the user.
% Q	Outputs Update	Writes output bits or words associated with discrete and application-specific modules.

Operating Mode

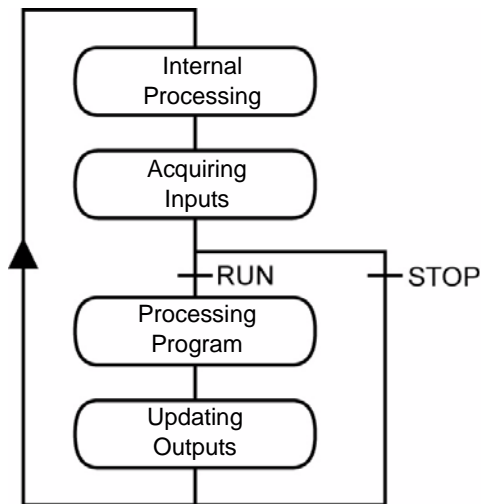
When ATV-IMC is in the RUN mode, the processor carries out:

- Internal Processing and Idle
- Inputs acquisition
- Program execution
- Outputs update

When ATV-IMC is in the STOP mode, the processor carries out:

- Internal processing
- Inputs acquisition

Operating Cycle



Check Cycle

The task watchdog, if defined, checks the duration of each cycle.

Cyclic Task

Introduction

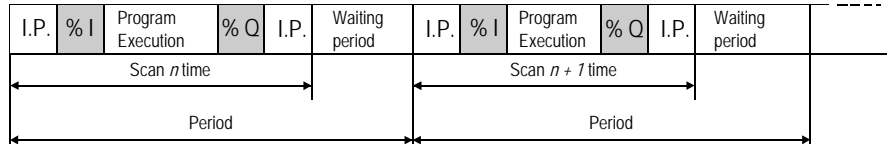
The cyclic scan time has a fixed duration (period) specified by the user.

If the current scan time is shorter than the cyclic scan time, the ATV-IMC waits until the cyclic scan time has elapsed before starting a new scan.

If the current scan time is longer than the cyclic scan time (Watchdog timer, see page 70), the controller automatically leaves RUN mode and enters STOP mode in EXCEPTION state.

Operation

The following diagram shows the operating phases of two consecutive scans.



Cycle Phases Description

Address	Phase	Description
I.P.	Internal processing	The system implicitly manages the communication ports, monitors the ATV-IMC (updating current timer values, updating status lights, detecting RUN/STOP switches, etc.) and processes requests from SoMachine (modifications and animation tables).
%I	Inputs Acquisition	Writes the status of discrete and application-specific module inputs to the memory.
-	Program Execution	Runs the application program written by the user.
%Q	Outputs Update	Writes output bits or words associated with discrete and application-specific modules.

Operating Mode

When ATV-IMC is in the RUN mode, the processor carries out:

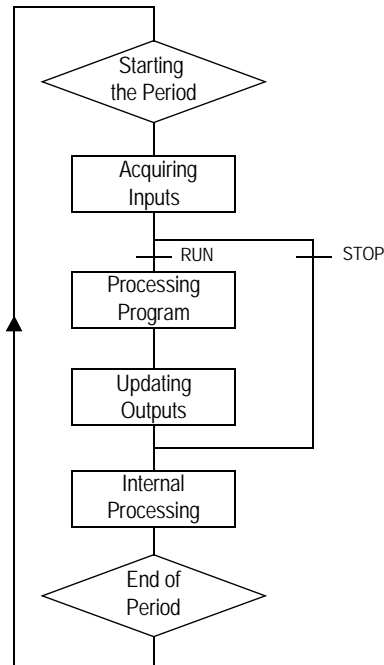
- Internal processing
- Inputs acquisition
- Program execution
- Outputs update

After updating the outputs, a controller in the RUN mode will wait until the defined MAST task duration has elapsed before beginning the next task.

When ATV-IMC is in the STOP mode, the processor carries out:

- Internal processing
- Inputs acquisition

Operating Cycle



Check Cycle

If defined, the event processing duration is checked by the task watchdog.

Event Task

Introduction

The event task is triggered by an event. The event can be external (typically the rising edge of an input).

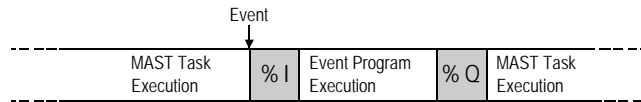
Event Task Trigger

An event task can be triggered by the following events:

- a rising/falling or both edge of fast inputs LI53 or LI54
- a synchronous event (on_SYNC)
- Controller Start (on_start) and controller Stop (on_stop)

Operation

The following timing diagram shows the running phases of the scan time.



Cycle Phases Description

The event interrupts the "mast task" execution. When event operation is done, then mast task restart.

Address	Phase	Description
%I	Inputs Acquisition	Writes the status of discrete and application-specific module inputs to the memory.
-	Event Program Execution	Runs the application program written by the user.
%Q	Outputs Updating	Writes output bits or words associated with discrete and application-specific modules.

Operating Mode

The event task interrupts the MAST task. The ATV-IMC executes the event task application according to defined priorities.

When ATV-IMC is in the RUN mode, the processor carries out:

- Inputs acquisition

- Event Program execution
- Outputs update

After the outputs are updated, the ATV-IMC resumes the MAST task.

Note: The event task refreshes the ATV-IMC I/Os used by the event task, but does not affect the I/Os of expansion modules.

The ATV-IMC does not detect conflicts if one event task changes an output value set by another task. Therefore, you must design the I/O mapping carefully.

WARNING

UNINTENDED EQUIPMENT OPERATION

Map your I/O so that event tasks do not alter the input images or output values in an unexpected manner.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Similarly, the %I phase of an event task can change inputs image, which are used by the event task, while they are processed by another task.

Check Cycle

The check cycle is performed by watchdog.

Watchdog Mechanisms

Introduction

There are two types of watchdog:

- Application (configured) watchdog
- System watchdog

Application (configured) Watchdogs

Each task cycle can be monitored by a watchdog timer (a maximum duration of the task cycle). This helps debugging certain application conditions (such as infinite loops, etc.) and provides a maximal duration for refreshing outputs.

A watchdog can be defined for each task.

If system overload is reached, then the application program detects an Application Watchdog (see page 63) overflow and enters the STOP state. In this case, the RUN LED blinks and the ERR LED is ON. The watchdog event is passed to the software console and identified as an exception with **PLC EXCEPTION** message. At the same time, the bottom right corner of the software window turns to red.

System Watchdog

System Overload is reached when the combined user tasks use more than 80% of system resources. This is computed on a 1 second window, each second.

This system overload mechanism cannot be disabled, so that system tasks can properly be executed.

If system overload is reached, then the application program detects an Application Watchdog (see page 63) overflow and enters the STOP state. In this case, the RUN LED blinks and the ERR LED is ON. The watchdog event is passed to the software console and identified as an exception with **PLC EXCEPTION** message. At the same time, the bottom right corner of the software window turns to red.

System Overload Acknowledge

After a **STOP due to watchdog** state, you must first issue a reset command (warm or cold), then the application can be restarted by a start command.

Fast Inputs



8

What in this Chapter ?

This chapter contains the following topics:

Topic	Page
HSC Modes	72
HSC Simple Mode	74
HSC Main Modes	75

HSC Modes

Introduction

ATV-IMC implements two High Speed Counters (HSC) : HSC 0 and HSC 1.

High Speed Counter functionalities are divided in two families:

- Simple Mode for basic functions
 - Counting down one shot,
 - Counting down modulo.
- Main Mode for "complex" functions
 - Counting one shot,
 - Counting modulo,
 - Counting up/down free (for quadrature encoder and other speed or position sensors),
 - Event counting,
 - Frequency meter.

ATV-IMC has 6 fast inputs and 4 general-purpose logical inputs. Most of all these inputs can be used for High Speed Counter.

HSC I/O Mapping

The table below shows the availability of the HSC functions according to the inputs :
(1) 100 kHz, 24 V \pm 10%

Digital input	Fast input (1)	Usage for HSC	
		HSC fast input	HSC general input
LI51	X	X	X
LI52	X	X	X
LI53	X		
LI54	X		
LI55			
LI56			X
LI57			X
LI58			
LI59	X	X	X
LI60	X	X	X

 WARNING

UNEXPECTED EQUIPMENT OPERATION

- Connect all fast inputs with shielded cables.
- Properly ground the cable shields as indicated in this documentation.

Failure to follow these instructions can result in death or serious injury, or equipment damage.

HSC Simple Mode

One Shot

The One Shot counter mode allows you to count a predefined number of pulses.

Principle: The counter starts decreasing from a preset value of a synchronization function. The decrease is made by each pulse applied to the leading edge of the synchronization input. The counter stops when its current value reaches 0 and the done bit is set. At this point, the counter current value is not modified by any new pulses from the input. The counter waits for the next synchronization to restart.

Example: The preset value may be a number of pieces to be packaged and the output may stop the packaging function or make a light go on.

Modulo

The Modulo Loop counter mode is used for applications for which actions are repetitive.

Configured in counting down modulo, the counter repeatedly counts from a user-defined value to 0.

HSC Main Modes

One Shot

This mode is the same as the one defined in HSC Simple. The difference is that "Enable" and "Preset" signals can be triggered by hardware inputs and the synchronization (edge configuration) can be configured (rising or falling edge).

Modulo

This mode is the same as the one defined in HSC Simple. The difference is that "Enable" and "Preset" signals can be triggered by hardware inputs and the synchronization (edge configuration) can be configured (rising or falling edge for enable. The preset is only on rising edge).

Free

The Free Large counter mode is for axis monitoring or labeling where the incoming position of each part has to be known.

Input Modes:

- "A" is first clock, "B" is second clock, direction is given by signal phase, Z signal can be used to preset,
 - Normal Quadrature X1, X2, X4,
 - Reverse Quadrature X1, X2, X4,
- "A" is first clock, "B" is direction, Z signal be used to preset.

Event Counting

The Event Counting mode is used to count a sequence of events over a given period of time.

Principle: The counter assesses the number of pulses applied on the input for a predefined period of time. The counting register is updated at the end of each period with the number of events received.

The event counter can be used while the synchronization bit is set to 1. Setting the bit to one starts the event counting for a predefined time period. The counting re-starts at the rising edge or at the falling edge of the synchronization input.

To find out how to configure this mode refer to the SoMachine Online Help.

Frequency Meter

The Frequency Meter mode allows the measurement of an event's frequency, speed, rate or flow.

Principle: The measured frequency is a mean frequency: number of events in the time interval converted to number of events per second (Hz).

To find out how to configure this mode refer to the SoMachine Online Help.

ATV-IMC Performances



9

What in this Chapter ?

This chapter contains the following topics:

Topic	Page
Performances	78

Performances

Logic Processing

The following table shows logic processing performance for various logical instructions:

IL Instruction Type	Duration for 1000 Instructions
Addition/subtraction/multiplication of INT	350
Addition/subtraction/multiplication of DINT	350
Addition/subtraction/multiplication of REAL	362
Division of REAL	690
Operation on BOOLEAN, e.g. Status:= Status and value	942
LD INT + ST INT	249
LD DINT + ST DINT	248
LD REAL + ST REAL	296

Communication and System Processing Time

The communication processing time varies, depending on the sent/received requests number.

