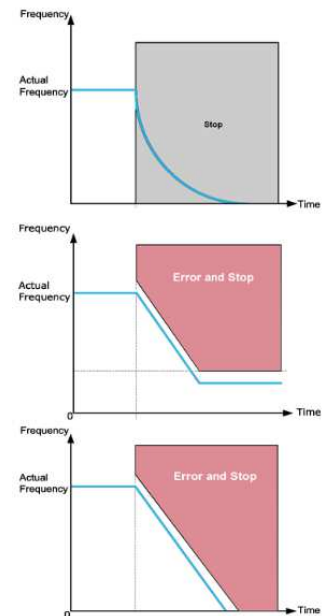


# GHD G<sub>lobal</sub> H<sub>elp</sub> D<sub>esk</sub>

## ATV32 SAFF fault diagnostic



ATV32 Safety Diagnostics

File: COM Settings: Sub-Menu

**Standard**

**Identification**

Drive Identification: Reference, Rating, Voltage

Drive Version: Product, Appl, MC

Drive Status: Status, Fault

**Safety Configuration**

Safe Status: SFTY

STO/SSI Parameters: STOA, SS1A

U/O Parameters: UOT, LRT

SLS Parameters: SLSA, SLSB, SLSL

Common Parameters: SSBT, SSB1, SSB2, SSB3

**Actual Safety Fault Registers**

Safety Fault Register: SFF0, SFF1, SFF2

Safety Fault Sub-Register: SFF3, SFF4, SFF5, SFF6, SFF7, SFF8, SFF9, SFF10, SFF11

**Fault history / Past time**

Fault History: DFF0, DFF1, DFF2, DFF3, DFF4, DFF5, DFF6, DFF7, DFF8

Past Time: RTD0, RTD1, RTD2, RTD3, RTD4, RTD5, RTD6, RTD7, RTD8

Upload Status: Next Change

Read Safety Diagnostic

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Revision 2.00

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## 1. ATV32 Safety evolution

### V1.5ie08

Correction on SAFF fault due to interruption of internal communication

### V1.8ie11

Add SLS Type 4 function

Add new parameter (STFR filtered) to be able to check safety speed.

All safety fault register are now accessible inside graphic keypad

All safety fault registered are now save in fault history area. The values are visible on keypad and can be read via communication (or dedicated tool).

Duplicate Safety configuration to another Drive

### V2.1ie15

Add SLS type 5 and 6 function

Remove filter on STFR to be able to check safety speed.

## 2. General information on ATV32 safety

There are many roots for a SAFF. It can be just due to drive configuration, due to instability on 24Vdc (connected to STO) or due to bad internal component.

On the ATV32, the safety kernel is always present with safety configured or not.

It's mean that the safety, check always if there is no issue on the safety channel.

For example the safety kernel, check always if there is no issue on the internal serial link (even if no safety are configured by SoMove)

It can explain SAFF even if the customer does not configure Safety with SoMove.

### How to diagnose the SAFF fault

In function of Drive version, it will have several way to check internal data about safety fault is order to identify SAFF root cause.

Major evolution about the SAFF diagnostic in the Drive was made since ATV32 version V1.8ie11.

This document will separate the diagnostic in 2 parts.

- Diagnostic of SAFF fault for drive up to version V1.5ie08
- Diagnostic of SAFF fault for drive since version V1.8ie11

### 3. SAFF on Drive power ON with ATV32 version before V1.5ie08

On Drive version before V1.5ie08, we can have SAFF fault without any safety configured in Drive. This SAFF was due to interruption of the internal communication

#### Interruption of the internal communication

- Check the ATV32 fault history (with keypad)

If you see in this fault history the sequence INF3, SAFF, INF3, SAFF ... then there is a possibility to be in this case.

- To be sure you need to read the SAF1 register (access only by communication at the address 15350 (or 16#207B/33 for CANopen)

If SAF1 = 0x0100 we are in this case.

#### Detail about the Interruption of the internal communication.

The SAFF origin can be due to an internal communication interruption (between the application and motor control). This interruption is due to a general reset of microcontroller cause by a fall down of internal supply when the STO input is connecting.

In other word when we Power ON the drive, without the STO connected and then we connect this STO input. On this step there is a fall down of internal supply which cause the reset and so the SAFF.

Today for this point, it's possible to reflash the ATV32 with lastest version (available on M&D TIP).



The V1.5ie08 corrects this particular case with interruption of internal communication.

There is always possibility to have SAFF fault for other reason and here it necessary to diagnose the root in using the provided tools.

### 4. Other causes of SAFF without safety configured in ATV32

- Instability detected (around 10,5V) on the STO input.
- Pulse (like relay rebound) on the STO input

#### Way to check if you are in these case for the instability or the Pulse on STO

- Check the SAF1 register (access only by communication at the address 15350 (or 16#207B/33 for CANopen)

If SAF1 = 0x0001 we are in one if these case. Then you need to check with oscilloscope the STO input when the SAFF appear.



Those instabilities or pulse on STO are always present on all drive version. This is not drive issue but link to signal send to STO input.

If you are in one of those case, the action must be on wiring in order to remove the pulse and stabilized the 24Vdc.

## 5. Tools and methods to diagnose the SAFF fault.

To diagnose the root of SAFF it's mandatory to check the safety register when the SAFF fault is present on the drive.

In function of Drive version the safety fault register will be accessible through different way

### Drive Version up to V1.5ie08

❖ We have a safety fault register visible in SoMove → parameter SFFE.

When an error is detected by the safety function, the drive displays [Safety function fault] (SAFF). This detected error can only be reset after powering the drive OFF/ON. For more information, you can access to the registers to find out the possible reasons for triggering. These registers can be displayed using the commissioning software

SFFE	Safety fault register	0000.0000.0000.0001
------	-----------------------	---------------------

### SFFE [Safety Function Fault Error Register]

Bit	Description
Bit0=1	Logic inputs debounce time-out (verify value of debounce time LIDT according to the application)
Bit1	Reserved
Bit2=1	Motor speed sign has changed during SS1 ramp
Bit3=1	Motor speed has reached the frequency limit threshold during SS1 ramp.
Bit4	Reserved
Bit5	Reserved
Bit6=1	Motor speed sign has changed during SLS limitation
Bit7=1	Motor speed has reached the frequency limit threshold during SS1 ramp.
Bit8	Reserved
Bit9	Reserved
Bit10	Reserved
Bit11	Reserved
Bit12	Reserved
Bit13=1	Not possible to measure the motor speed (verify the motor wiring connection)
Bit14=1	Motor ground short-circuit detected (verify the motor wiring connection)
Bit15=1	Motor phase to phase short-circuit detected (verify the motor wiring connection)

This register is reset after powering OFF/ON.

This register can also be accessed from [DRIVE MENU] --> [MONITORING] --> [MONIT. SAFETY]

The SFFE is the first level of SAFF fault diagnostic, but in some case (especially if SAFF occur when no safety is configured), the SFFE parameters will stay 0.

For this reason, inside the Drive we also have internal fault code for safety but with only access by communication (for version up to V1.5ie08)

To easily have access to the mandatory safety register, we develop a software tool (ATV32 safety diagnostic tool). This software will check the safety fault register inside the drive when the SAFF fault is present.

**This software is available on Lotus Notes M&D TIP database**

Category: Product

Sub category: ATV\*2\ATV32\Software tools

▼ PRODUCTS
▶ Accessories
▶ ATS
▶ ATV1000/1100
▶ ATV*1
▼ ATV*2
▶ ATV12
▶ ATV212
▶ ATV302
▶ ATV312
▼ ATV32
▶ Software information
▼ Software tools
23/04/2012    ATV32 Safety Diagnostic Tool

### Drive Version since V1.8ie11

- ❖ We have a safety fault register visible in Keypad and SoMove → parameter **SFFE**.

When an error is detected by the safety function, the drive displays [Safety function fault] (SAFF). This detected error can only be reset after powering the drive OFF/ON. For more information, you can access to the registers to find out the possible reasons for triggering. These registers can be displayed using the graphic display terminal or the commissioning software: **[DRIVE MENU] --> [MONITORING] --> [DIAGNOSTICS] --> [MORE FAULT INFO]**

SFFE	Safety fault register	0000.0000.0000.0001
------	-----------------------	---------------------

#### SFFE [Safety Function Fault Error Register]

Bit	Description
Bit0=1	Logic inputs debounce time-out (verify value of debounce time LIDT according to the application)
Bit1	Reserved
Bit2=1	Motor speed sign has changed during SS1 ramp
Bit3=1	Motor speed has reached the frequency limit threshold during SS1 ramp.
Bit4	Reserved
Bit5	Reserved
Bit6=1	Motor speed sign has changed during SLS limitation
Bit7=1	Motor speed has reached the frequency limit threshold during SS1 ramp.
Bit8	Reserved
Bit9	Reserved
Bit10	Reserved
Bit11	Reserved
Bit12	Reserved
Bit13=1	Not possible to measure the motor speed (verify the motor wiring connection)
Bit14=1	Motor ground short-circuit detected (verify the motor wiring connection)
Bit15=1	Motor phase to phase short-circuit detected (verify the motor wiring connection)

This register is reset after powering OFF/ON.

This register can also be accessed from **[DRIVE MENU] --> [MONITORING] --> [MONIT. SAFETY]**

The SFFE is the first level of SAFF fault diagnostic, but in some case (especially if SAFF occur when no safety is configured), the SFFE parameters will stay 0.

- ❖ We have all internal safety fault register visible in Keypad and SoMove → parameter SAF1, SAF2, SF00 to SF11.

These registers can be displayed using the graphic display terminal or the commissioning software: **[DRIVE MENU] --> [MONITORING] --> [DIAGNOSTICS] --> [MORE FAULT INFO]**

SAF1	Safety fault Reg1	0000.0010.0000.0000
SAF2	Safety fault Reg2	0000.0000.0000.0000
SFFE	Safety fault register	0000.0000.0000.0001
SF00	SAFF Subcode 0	0000.0000.0000.0000
SF01	SAFF Subcode 1	0000.0000.0000.0000
SF02	SAFF Subcode 2	0000.0000.0000.0000
SF03	SAFF Subcode 3	0000.0000.0000.0001
SF04	SAFF Subcode 4	0000.0000.0000.0000
SF05	SAFF Subcode 5	0000.0000.0000.0000
SF06	SAFF Subcode 6	0000.0000.0000.0000
SF07	SAFF Subcode 7	0000.0000.0000.0000
SF08	SAFF Subcode 8	0000.0000.0000.0000
SF09	SAFF Subcode 9	0000.0000.0000.0000
SF10	SAFF Subcode 10	0000.0000.0000.0000
SF11	SAFF Subcode 11	0000.0000.0000.0000

See the SoMove online Help, to have meaning of each bit.

If also possible to use internal software tool (ATV32 safety diagnostic tool). This software will check the safety fault register inside the drive when the SAFF fault is present. It will also allow seeing that past fault history with safety sub fault code registered.

### This software is available on Lotus Notes M&D TIP database

Category: Product

Sub category: ATV\*2\ATV32\Software tools

▼ PRODUCTS
▶ Accessories
▶ ATS
▶ ATV1000/1100
▶ ATV*1
▼ ATV*2
▶ ATV12
▶ ATV212
▶ ATV302
▶ ATV312
▼ ATV32
▶ Software information
▼ Software tools
23/04/2012    ATV32 Safety Diagnostic Tool

❖ **New parameter STFR allow to check drive internal speed (Stator frequency)**

To understand the need of this parameter, it's mandatory to know how the motor is driven by the ATV32.

On Asynchronous motor, the rotor speed correspond (in simplified way) to the frequency of magnetic field - slip.

On the drive we have several parameter to display the output speed of motor (RFR and RFRD) but those parameter display the rotor frequency.

Inside the safety kernel, the safety threshold or limit work with stator speed (not the rotor speed). For this reason it's not possible to compare RFR (or RFRD) to safety threshold.

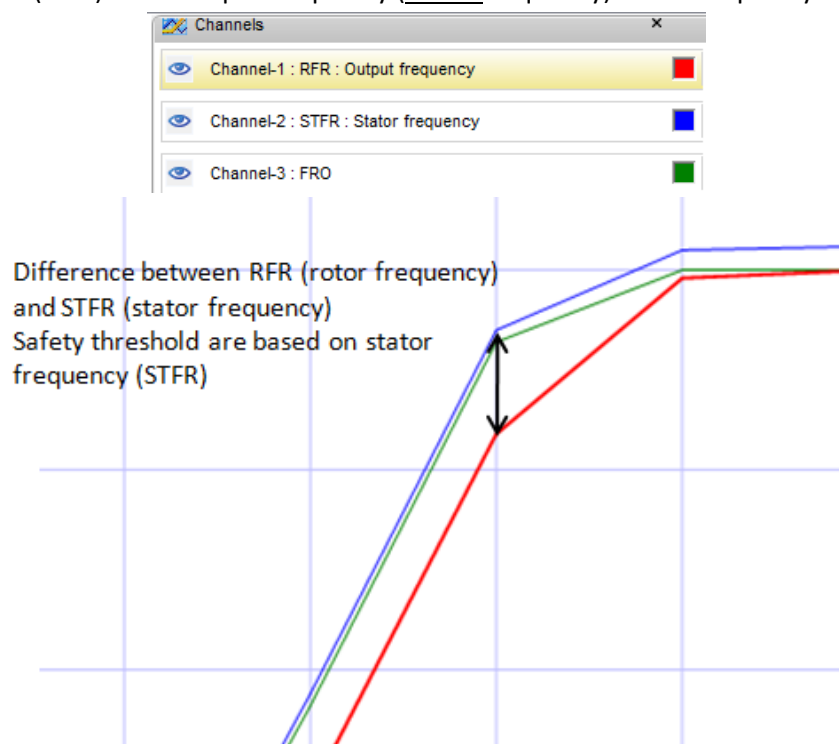
To have good comparison, we have to compare stator frequency (STFR) to safety threshold.

Example

FRO (Green) show the frequency reference after ramp calculated by the drive

RFR (Red) is the output frequency (rotor frequency): stator frequency – slip

STFR (Blue) is the output frequency (stator frequency): rotor frequency + slip



Like you see Rotor frequency (RFR) and Stator Frequency (STFR) are different. We have the slip between both values.

With safety threshold configured, it's important to check the STFR parameters and not the RFR.



STFR is available in SoMove slow scope.



❖ **The safety fault register are also memorized in fault history.**

This feature allows knowing if the root cause is always the same in case of several SAFF on a Drive.

These registers can be displayed using the graphic display terminal or the commissioning software: **[DRIVE MENU] --> [MONITORING] --> [DIAGNOSTICS] --> [FAULT HISTORY]**

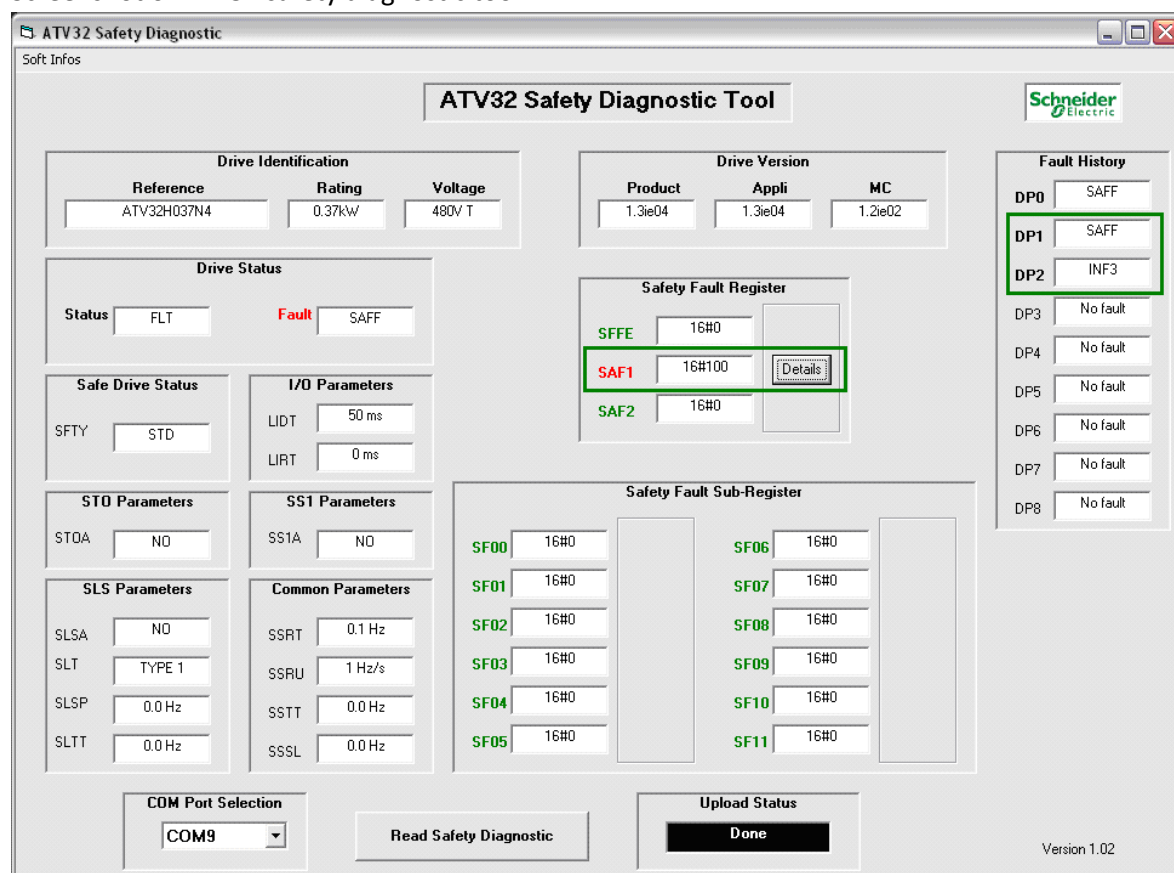
For each SAFF fault registered in the fault history, you can see inside the keypad the value of safety fault registers.

Those registers are also available via ATV32 safety Diagnostic tool.

## 6. Example of SAFF on ATV32 without safety configured.

**SAFF fault trip when the STO is connected to 24Vdc after a long time in power OFF.**

Screenshot of ATV32 safety diagnostic tool



Note : This screenshot was made with old version of ATV32 safety diagnostic tool. On tool V2.00, the look and feel is different but the register value will be the same.

The SAF1 = 16#100 and in the fault history we can see fault SAFF – INF3



**Result:** in this particular case the SAFF root was due to interruption of internal communication.

The solution is to update the product with version V1.5ie08 or higher





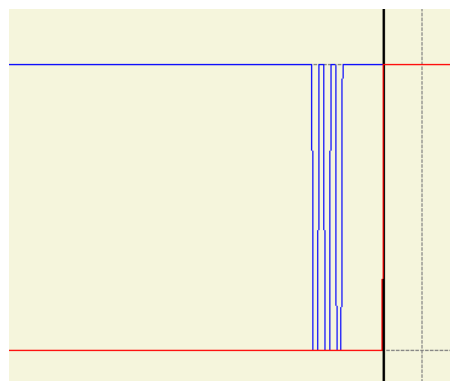
**Result:**

In this case the SAFF root is on the STO consistency check. It can come from instability of STO input or pulse on this STO input.

To check this you need to spy with oscilloscope the STO input and check if you see instability or pulse.

This type of SAFF with SAF1 = 16#0001 could also come from bad internal connexion between the control bloc and the Power card. For this Expertise of product is needed (TEX)

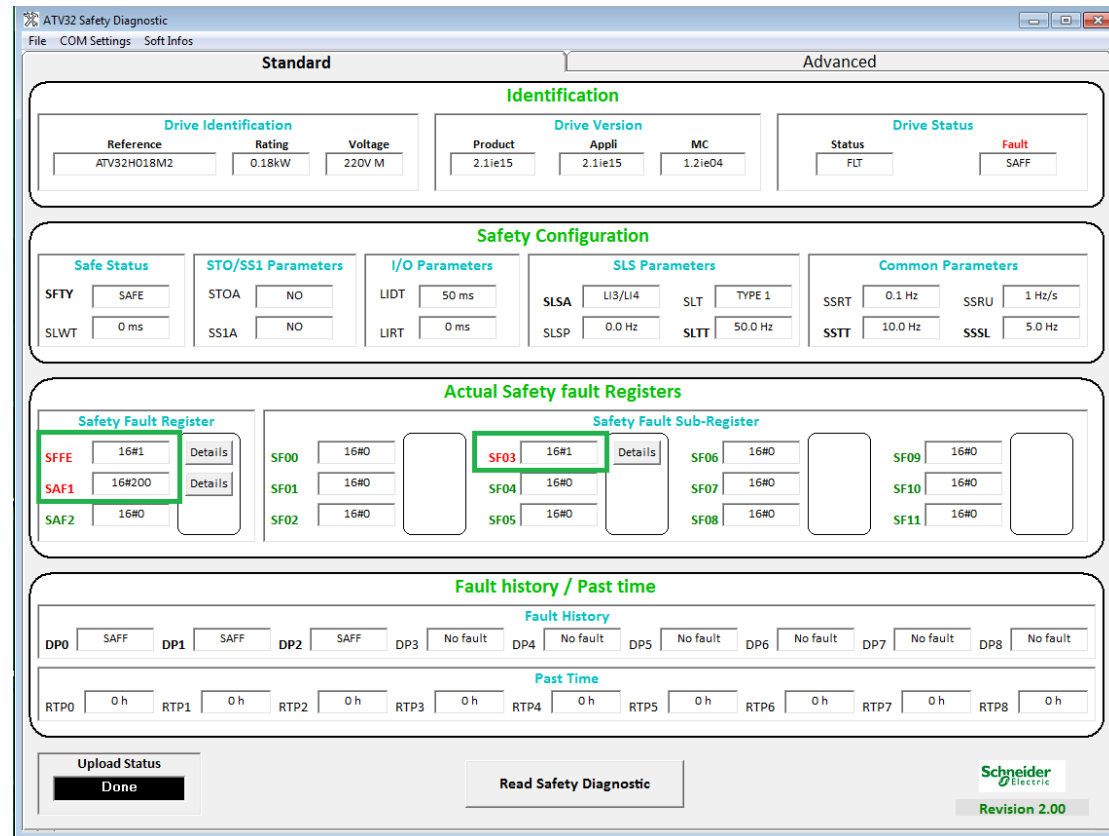
Pulse example which can generate SAFF fault (with SAF1 = 1). Blue are the pulse on STO and Red is the detection of SAFF.



## 7. Example of SAFF on ATV32 with safety configured.

### SAFF fault trip on safety sensor activation

Screenshot of ATV32 safety diagnostic tool



**ATV32 Safety Diagnostic**

File COM Settings Soft Infos

**Standard** **Advanced**

**Identification**

**Drive Identification**

Reference	Rating	Voltage
ATV32H018M2	0.18kW	220V M

**Drive Version**

Product	Appli	MC
2.1ie15	2.1ie15	1.2ie04

**Drive Status**

Status	Fault
FLT	SAFF

**Safety Configuration**

**Safe Status**

SFTY	SAFE
SLWT	0 ms

**STO/SSI Parameters**

STOA	NO
SSI1A	NO

**I/O Parameters**

LIDT	50 ms
LIRT	0 ms

**SLS Parameters**

SLSA	LI3/LI4	SLT	TYPE 1
SLSP	0.0 Hz	SLTT	50.0 Hz

**Common Parameters**

SSRT	0.1 Hz	SSRU	1 Hz/s
SSTT	10.0 Hz	SSSL	5.0 Hz

**Actual Safety fault Registers**

**Safety Fault Register**

SFFE	16#1	Details
SAF1	16#200	Details
SAF2	16#0	

**Safety Fault Sub-Register**

SF00	16#0	
SF01	16#0	
SF02	16#0	
SF03	16#1	Details
SF04	16#0	
SF05	16#0	
SF06	16#0	
SF07	16#0	
SF08	16#0	
SF09	16#0	
SF10	16#0	
SF11	16#0	

**Fault history / Past time**

**Fault History**

DP0	SAFF	DP1	SAFF	DP2	SAFF	DP3	No fault	DP4	No fault	DP5	No fault	DP6	No fault	DP7	No fault	DP8	No fault
-----	------	-----	------	-----	------	-----	----------	-----	----------	-----	----------	-----	----------	-----	----------	-----	----------

**Past Time**

RTP0	0 h	RTP1	0 h	RTP2	0 h	RTP3	0 h	RTP4	0 h	RTP5	0 h	RTP6	0 h	RTP7	0 h	RTP8	0 h
------	-----	------	-----	------	-----	------	-----	------	-----	------	-----	------	-----	------	-----	------	-----

**Upload Status**

**Done**

**Read Safety Diagnostic**

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**Revision 2.00**

The SFFE = 16#1, SAF1 = 16#200, SF03 = 16#1

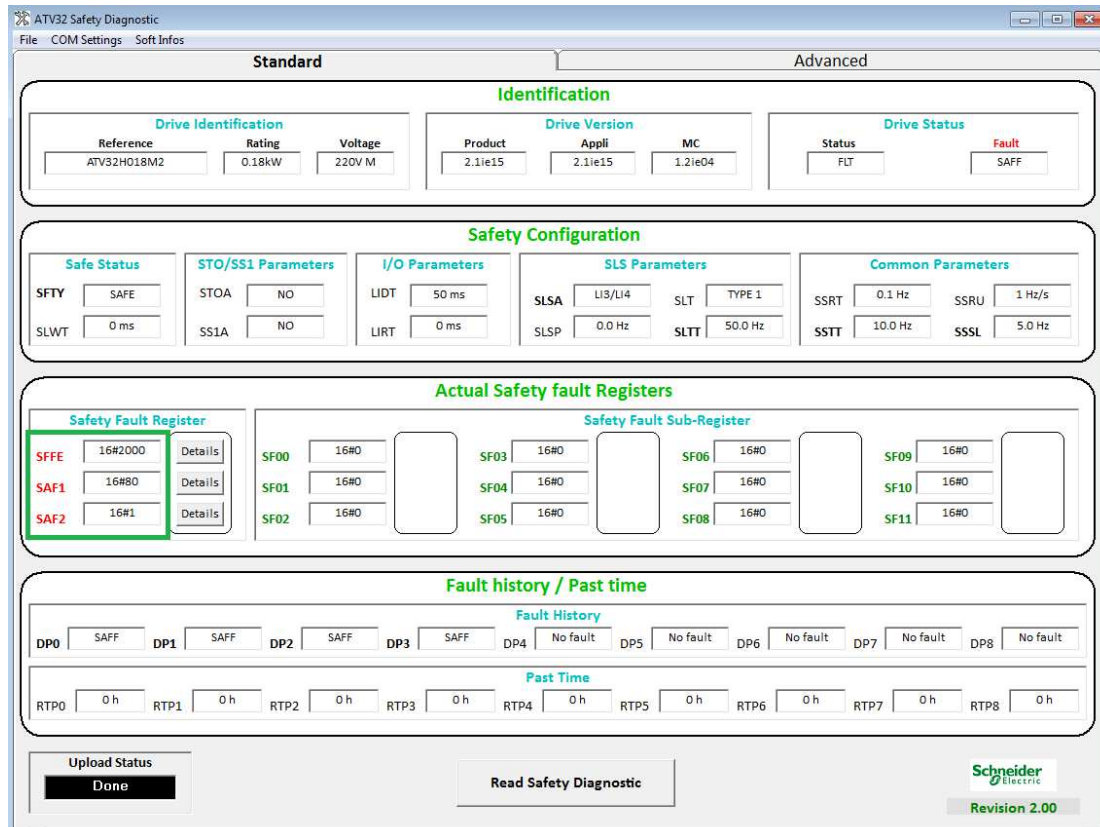


**Result:** In this case the SAFF root is the bad synchronization of safety input. This can be solving with the configuration of LIDT parameter.

<b>L I d t</b>	<b>[LI debounce time]</b>	1 to 2000 ms	50
<p>In most of the case, both LI of a safe LI couple (LI3 and LI4, LI5 and LI6) will not be 100% synchronized. They will not change of state in the same time. There is a small delta between both LI transition.</p> <p><b>L I d t</b> is the parameter used to set this delta. If both LI change states with a delta in time smaller than <b>L I d t</b> it is considered as a simultaneous transition of the LI.</p> <p>If delta in time is greater than <b>L I d t</b>, drive considers that LI are no more synchronized and a Safe detected fault is triggered.</p>			

## SAFF fault trip randomly

Screenshot of ATV32 safety diagnostic tool



The SFFE = 16#2000, SAF1 = 16#80, SAF2 = 16#1



**Result:** In this case the SAFF root is bad connexion of motor (output phase loss). So in this case it's needed to check the motor connexion.

## 8. Recommendations / Mandatory information

Inside the ATV32, there are 15 safety fault registers.

Each bit of these words corresponds to a possible SAFF root cause. The examples describe before, are just a part of possible SAFF fault on ATV32.

You can see that even if you see SAFF display on product, the root can be completely different between 2 SAFF.

With ATV32 version V1.5ie08 and before, we can only see safety fault register value with safety diagnostic tool AND only when SAFF fault is present.

Now since version V1.8ie11 and higher, we can have access to those register in keypad, in SoMove and in ATV32 safety diagnostic tool.

### Keypad access



### SoMove access

SoMove 2.0 - Untitled Project.psx\*

File View Communication Device Tools Help

data are synchronized

My Device	Operate	Parameters	Errors detection	Monitoring	Scope
<div> <div> <div>ATV32</div> <div> <div>Monitoring Parameters</div> <div> <div>FRH &gt; Freq. ref. before ramp</div> <div>AIV1 &gt; Image input AIV1</div> <div>RFR &gt; Output frequency</div> <div>LCR &gt; Motor current</div> <div>RPE &gt; PID error</div> <div>RPF &gt; PID feedback</div> <div>RPI &gt; Internal PI reference</div> <div>RPC &gt; PID reference</div> <div>ULN &gt; Line mains voltage</div> <div>THR &gt; Motor thermal state</div> <div>THD &gt; Drive thermal state</div> <div>OPR &gt; Motor power</div> <div>RTH &gt; Motor run time</div> <div>PTH &gt; Power on time</div> <div>I2TM &gt; overload level of I<sup>2</sup>t</div> </div> </div> <div>Status of safety functions</div> </div> </div>					
Code	Long Label				
STOS	Safe Torque Off Status			Safe stop	
SLSS	Safe limited speed status			Not config.	
SS1S	Safe stop 1 status			Idle	
SFFE	Safety fault register			0010.0000.0000.0000	
STFR	Stator frequency			0 Hz	
SAF1	Safety fault Reg1			0000.0000.1000.0000	
SAF2	Safety fault Reg2			0000.0000.0000.0001	
SF00	SAFF Subcode 0			0000.0000.0000.0000	
SF01	SAFF Subcode 1			0000.0000.0000.0000	
SF02	SAFF Subcode 2			0000.0000.0000.0000	
SF03	SAFF Subcode 3			0000.0000.0000.0000	
SF04	SAFF Subcode 4			0000.0000.0000.0000	
SF05	SAFF Subcode 5			0000.0000.0000.0000	
SF06	SAFF Subcode 6			0000.0000.0000.0000	
SF07	SAFF Subcode 7			0000.0000.0000.0000	
SF08	SAFF Subcode 8			0000.0000.0000.0000	
SF09	SAFF Subcode 9			0000.0000.0000.0000	
SF10	SAFF Subcode 10			0000.0000.0000.0000	
SF11	SAFF Subcode 11			0000.0000.0000.0000	

## ATV32 safety diagnostic tool

ATV32 Safety Diagnostic

File COM Settings Soft Infos

**Standard** **Advanced**

**Identification**

**Drive Identification**

Reference	Rating	Voltage
ATV32H018M2	0.18kW	220V M

**Drive Version**

Product	Appli	MC
2.1ie15	2.1ie15	1.2ie04

**Drive Status**

Status	Fault
FLT	SAFF

**Safety Configuration**

**Safe Status**

SFTY	SAFE
SLWT	0 ms

**STO/SS1 Parameters**

STOA	NO
SS1A	LI3/LI4

**I/O Parameters**

LIDT	500 ms
LIRT	0 ms

**SLS Parameters**

SLSA	NO	SLT	TYPE 1
SLSP	0.0 Hz	SLTT	50.0 Hz

**Common Parameters**

SSRT	1.0 Hz	SSRU	10 Hz/s
SSTT	5.0 Hz	SSSL	5.0 Hz

**Actual Safety fault Registers**

**Safety Fault Register**

SFFE	16#2000	Details
SAF1	16#80	Details
SAF2	16#1	Details

**Safety Fault Sub-Register**

SF00	16#0	SF03	16#0	SF06	16#0	SF09	16#0
SF01	16#0	SF04	16#0	SF07	16#0	SF10	16#0
SF02	16#0	SF05	16#0	SF08	16#0	SF11	16#0

**Fault history / Past time**

**Fault History**

DP0	SAFF	DP1	SAFF	DP2	SOF	DP3	SAFF	DP4	SAFF	DP5	SAFF	DP6	SAFF	DP7	No fault	DP8	No fault
-----	------	-----	------	-----	-----	-----	------	-----	------	-----	------	-----	------	-----	----------	-----	----------

**Past Time**

RTP0	0 h	RTP1	0 h	RTP2	0 h	RTP3	0 h	RTP4	0 h	RTP5	0 h	RTP6	0 h	RTP7	0 h	RTP8	0 h
------	-----	------	-----	------	-----	------	-----	------	-----	------	-----	------	-----	------	-----	------	-----

Upload Status  
Done

Read Safety Diagnostic

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ATV32 Safety Diagnostic

File COM Settings Soft Infos

**Standard** **Advanced**

**Fault history / Past time**

Fault history	Actual fault	Fault (-1)	Fault (-2)	Fault (-3)	Fault (-4)	Fault (-5)	Fault (-6)	Fault (-7)	Fault (-8)
	SAFF	SAFF	SOF	SAFF	SAFF	SAFF	SAFF	No fault	No fault
Past time	0 h	0 h	0 h	0 h	0 h	0 h	0 h	0 h	0 h

**Safety Fault Register History**

SAF1_details	16#80	16#80	16#0	16#1000	16#80	16#200	16#1	16#0	16#0
SAF2_details	16#1	16#0	16#0	16#0	16#1	16#0	16#0	16#0	16#0
SF00 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF01 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF02 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF03_details	16#0	16#0	16#0	16#0	16#0	16#1	16#0	16#0	16#0
SF04 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF05_details	16#0	16#0	16#0	16#4	16#0	16#0	16#0	16#0	16#0
SF06 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF07 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF08 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF09 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF10 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0
SF11 history	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0	16#0

Upload Status  
Done

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Checks the safety fault register in the Drive fault history allow checking if SAFF origin is always the same.



**For SAFF fault diagnostic, we need to have detailed information on:**

- The ATV32 version
- The SAFF trip (on power on, when the STO input is connected, randomly during normal working...)
- The screenshot of safety diagnostic tool, SoMove or Keypad with safety fault registers
- It's also good to measure (with oscilloscope) the value of 24Vdc connected on STO input. (The goal is to check the stability and/or if there are pulse on STO input)
- Electrical schematic to know how are connected the ATV32 safety inputs.
- In some case the SAFF origin can be due to product, so in this case Product Expertise (TEX) could be mandatory.