SUMO MD MV/HV Powertrain
Troubleshooting Guide

March 2021

Safety Warnings

The description and specifications contained in the service publication are current at the time of printing. Dana TM4 reserves the right to discontinue or modify its models and/or procedures and to change specifications at any time without notice.

Any reference to brand name in this publication is made as an example of the types of tools and materials recommended for use and should not be considered an endorsement. Equivalents may be used.

IMPORTANT NOTICE

This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, materials and recommended parts mentioned in this publication may jeopardize the personal safety of the service technician or vehicle operator.

WARNING: Failure to follow indicated procedures creates a high risk of personal injury to the servicing technician

CAUTION: Failure to follow indicated procedures may cause component damage or malfunction.

IMPORTANT: Highly recommended procedures for proper service of this unit

Note: Additional service information not covered in the service procedures.

Tip: Helpful removal and installation procedures to aid in the service of this unit

Always use genuine Dana TM4 replacement parts.

WARNING

This symbol is used throughout this guide to warn for electrical dangers. Failure to abide to the related safety instructions may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, materials and recommended parts mentioned in this publication may jeopardize the personal safety of the service technician or vehicle operator.

Every effort has been made to endure the accuracy of all information in this guide. **However, Dana TM4 Commercial Vehicle Systems Division makes no expressed or implied warranty or representation based on the enclosed information.**

Any errors or omissions may be reported to:
Marketing Services
Dana TM4 inc.
135, Joseph-Armand Bombardier, #25
Boucherville (Québec) J4B 8P1 Canada

⚠ WARNING

This product generates high voltage that can cause an electric discharge or electrocution resulting in injury or death.
When installing the product, verify that:

- The traction battery (high-voltage battery) is disconnected.
- The auxiliary battery (12V/24V battery) is disconnected.

Care must be taken when manipulating electrical equipment.

This product must be installed by qualified and authorized personnel in accordance with applicable vehicle standards and industry practices. Always use appropriate insulation and protection before manipulating the product even when the product is disconnected from a high-voltage source.

⚠ WARNING

Mishandling of this product may damage the product and/or cause injury or death.

- All limitations and specifications communicated by Dana TM4 regarding the product must be respected.
- Do not attempt to open, repair or modify the Motor Control Unit (MCU). In case of damaged casing or suspected product malfunction, contact Dana TM4 Customer Service.
- Use only recommended points to lift and secure the MCU.
- When using straps to lift the MCU, ensure they do not touch or put pressure on any part of the product exterior (surface, connectors, and/or cables).
- Do not attach the motor to the MCU using a shared support or bracket.
- Do not apply any external load to the casing of the MCU.

⚠ WARNING

The high-voltage cables MUST be shielded:
The external cables used for high voltage must be orange and shielded; the high voltage and level of current delivered by this product can be lethal.
Failure to shield the high-voltage cables will result in non-compliance with EMI regulatory requirements.

This product uses differential mode capacitors between the positive high-voltage DC bus (+) and the negative high-voltage DC bus (-) and common mode capacitors between the high-voltage DC bus and the chassis.

Even when the product is disconnected from the high-voltage source, these capacitors can hold a voltage high enough to cause an electric discharge or death.

⚠ WARNING

Regardless of the cooling system used, when in a system, the MCU can be irreparably damaged and may become unstable if the coolant liquid pressure reaches or exceeds a pressure of 30 PSI (static pressure measured at the entrance of the MCU – upstream of the MCU in the circuit).

Ensure that the pump is adjusted accordingly.
The cooling agent contains ethylene glycol that is a highly flammable product. Ethylene glycol can burn with an invisible flame that can cause serious burns and/or other injuries.
Always handle the cooling agent carefully wearing appropriate safety clothing and eye-glasses.
The cooling agent can irritate the skin, the eyes and the mucous membranes.

- Always work in a well-ventilated area when handling the cooling agent; breathing in high concentrations of ethylene glycol can cause nausea.
- In case of contact with eyes and skin, rinse with water and consult a doctor.
- In case of ingestion, seek medical help immediately.

The cooling agent is under pressure when heated; removing the cap when the coolant is hot can cause serious burns and/or other injuries.
Wait until the coolant reaches an ambient temperature before removing the cap.
All potential dangers of handling cooling agents cannot be listed here.
Consult manufacturer warnings and recommendations for safe handling of the cooling agent.

⚠ CAUTION

It is important to ensure that no voltage is present on the high-voltage battery wires between both polarities and from each polarity to chassis before manipulation.

The vehicle integrator is responsible for ensuring that proper training is given to all those who use this system in order to avoid physical, electrical and operational hazards.

General Information

Acronyms - Symbols

A	Ampere unit
AC	Alternative Current
ACDC	Alternative Current to Direct Current
ASTM	American Society for Testing and Materials
Auxiliary Battery	Standard 12V or 24V vehicle battery
AWG	American Wire Gauge
BIM	Battery Interface Module
BMS	Battery Management System
Board Net	Standard 12V or 24V vehicle network
CAN	Control Area Network communication protocol
CANxH	CAN x High
CANxL	CAN x Low
COS	Cosinus
CRC	Cyclic Redundancy Check
°C	Degree Celsius unit
DC	Direct Current
DCDC	Chopper circuit DC to DC
DSP	Digital Signal Processor
ECU	Electronic Control Unit
EMF	ElectroMotive Force
ESD	ElectroStatic Discharge
EV	Electrical Vehicle
GΩ	Giga Ohm unit
GDD	TM4 ODIN Gathered Diagnostic Data sub program
h	hour unit
HVIL	Hazardous Voltage Interlock Loop
HS	High Side
kW	kiloWatt unit
kΩ	KiloOhm unit
mA	Milliampere unit
L	Liter unit
L/h	Liter per hour unit
MΩ	Mega Ohm unit
MCU	Motor Control Unit
Nm	Newton meter unit
%	Percentage
PC	Personal Computer
PDU	Power Distribution Unit
POC	POwer Connector
P/N	Part Number
PSI	Pound-force per Square Inch unit
PWM	Pulse Width Modulation
RPM	Rotation Per Minute unit
SIN	Sinus
SysFile ID	Service Code
TM4 ODIN	Dana TM4 diagnostic software
USB	Universal Serial Bus
V	Volt unit
Vaux	Auxiliary battery voltage (12 V or 24 V)
VMU	Vehicle Management Unit

Key Features

Dana TM4 Motor Control Unit (MCU)

The Motor Control Unit (MCU) system is operated via CAN message communication between the MCU and the Vehicle Management Unit (VMU) or Electronic Control Unit (ECU).

The VMU or ECU is in charge of the user interface and also interfaces with the Battery Management System (BMS) and all other systems included in the vehicle architecture.

The typical operation functions are:

- Applying power to the system from the auxiliary battery.
- Asserting the enable signal to the MCU (VMU /ECU or vehicle ignition).
- Performing high-voltage battery pre-charge (VMU/ECU or BMS).
- Applying high-voltage battery voltage to the system (BMS or BIM).
- Transmitting CAN messages (VMU/ECU) with the MCU:
    - Starting and stopping the system.
    - Applying a mechanical torque.
    - Safely shutting down the system.
    - Verifying operational status.

Hazardous Voltage Interlock Loop (HVIL)

The Hazardous Voltage Interlock Loop (HVIL) internal loop is closed, resulting in a short circuit between its two input pins. The HVIL signal is used to open the high-voltage battery contactor when its internal loop is opened during product maintenance or repair (e.g. removal of the MCU cover (MCU with removable side cover) or disconnection of motor sensor cable) thereby protecting the user.

Diagnostics Capability and Troubleshooting

Troubleshooting can be performed with the TM4 ODIN tool. It gives the list of events that occurred during the operation and categorized the events such as:

- Errors, which cause the product to cease operation.
- Warnings and Information level events are also recorded and must be taken into consideration even though the product will remain operational.

Disclaimer

Dana TM4 is not responsible for prolonged use of product with one or more defective sensors as this could cause permanent damage to the product and injury to the user. As soon as any of the system's sensors fails, the vehicle must be returned to the garage for inspection and repair.

Safety Instructions

This product must be installed and manipulated by qualified personnel who are fully aware of the types of hazards involved in working with electrical circuitry and are familiar with standard practices for preventing accidents. The vehicle integrator is responsible for ensuring that proper training is given to all those who use this system in order to avoid physical, electrical and operational hazards.

Safety warning related to operating the system

Mishandling of this product may damage the product and/or cause injury or death.

- Do not attempt to open or repair this product. In case of damaged casing or suspected product malfunction, contact Dana TM4.
- Use only recommended points to lift and secure the system.

When manipulating and/or installing this product, you must NOT:

- Modify any part of the MCU.
- Apply any external load to the casing of the MCU.

Applying excessive torque or speed when the motor is cold may negatively impact the durability of the system.

When the motor is used in an environment with an ambient temperature of below 0°C, it is recommended that you avoid using excessive speed or torque and follow a normal driving cycle for the first few minutes until the motor vehicle mechanical equipment has had a chance to warm up.

Note: This is a best practice commonly applicable to any mechanical equipment. The Dana TM4 motor does not limit performance; full speed and torque are available, but not recommended, after a cold start.

Dana TM4 Motor and MCU Components (This is an example)

Dana TM4 Motor

Dana TM4 MCU

System Specifications

The motorization system is composed of the MCU and motor.
Refer to the System Specification guide for your system.
The table below is an example.

The MCU has the following connectors:

- Communication connector.
- Grounding Point.
- DC connectors.
- Phase Connectors.
- Motor Sensor Connectors.
- Coolant IN / OUT connectors.

Characteristics	Value	
Electrical Specification		
Traction Battery		
Operating Voltage	300 - 750 V_{DC}	
Maximum non-operating voltage	775 V_{DC}	
Maximum current	615 A_{DC}	
Maximum Continuous Current	350 A_{DC}	
Auxiliary Battery		
Operational range	8 - 32 V_{DC}	
Maximum non-operating voltage	36 V_{DC}	
Maximum steady state current	4.5 A_{DC} @ 12 V_{DC}; 3 A_{DC} @ 24 V_{DC}	
Maximum inrush current	<10 A_{DC}	
Maximum quiescent current	<0.6mA_{DC} @ 8 V_{DC}; <1.2mA_{DC} @ 32 V_{DC}	
Maximum System Efficiency	95.3%	
CAN interface version	2.0b	
Motor Control Unit Short-Circuit Protection	Yes	
Motor Control Unit Over-Current Protection	Yes	
System Specification		
Characteristics	**Designed**	**Measured**
Maximum Mechanical Output Power	250 kW	265 kW for 47 seconds
Maximum Mechanical Output Torque	2645 Nm	2761 Nm for 30 seconds
Maximum Mechanical Output Torque at 0 RPM	2645 Nm	2731 Nm for 18 seconds
Continuous Mechanical Output Power	-	154 kW
Continuous Mechanical Output Torque	-	969 Nm
Normal Operating Range	0 - 3500 RPM	
Derating Range	3500 – 3700 RPM	
Overspeed Range	3700 – 4200 RPM for less than 2 minutes	
Environmental and cooling features		
Coolant temperature*	-40 °C to 85 °C	
Ambient temperature*	-40 °C to 85 °C	
Storage Temperature	-40 °C to 85 °C	
Cooling System	40% deionized water / 60% glycol	
Motor and MCU maximum allowed working pressure	30 PSI	
Motor Coolant Flow Rate	1200L/h	
MCU Coolant Flow Rate	1200L/h	

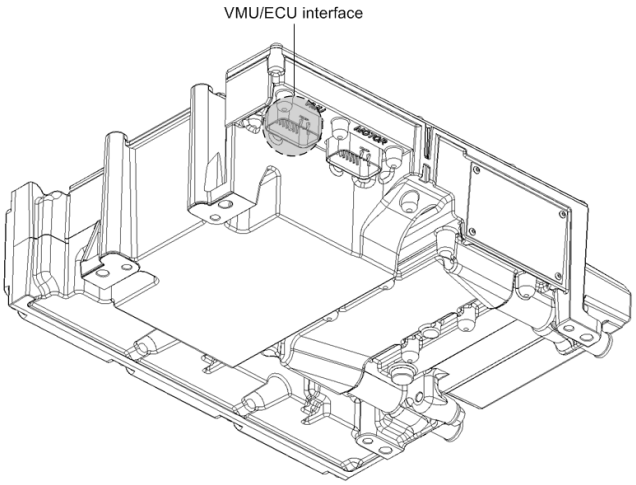
Component Description

Communication connector

An interface harness is used between the MCU and the VMU/ECU. The communication harness that is connected to the MCU contains all required signals to interface the MCU with the VMU/ECU, including the enable signal, the CAN ports and the CAN signals.

Type 2 connector

The communication connector has 23 pins with the following specification:

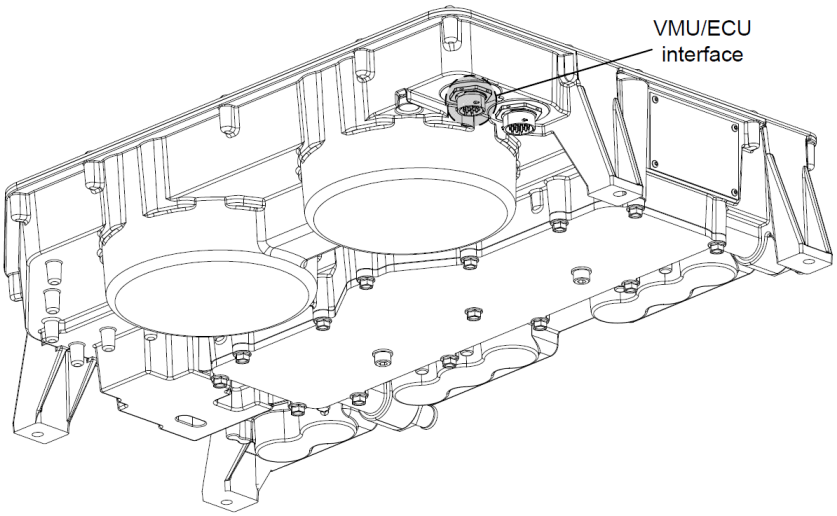


VMU/ECU interface harness – Plug pinout specifications 1-776228-1 (Type 2)

PIN	Signal Name		Types	AWG	Description
1	Ignition	Input	20-16	Enable signal to the Motor Control Unit.	
2	CAN2L	Communication	20-16	Low level of differential signal CAN2.	
3	CAN SHIELD	Ground/Shield	20-16	Typical CAN shield.	
4	PWM1_OUT	Low side output	20-16	Generic Low side Output 1A, can be used as PWM.	
5	ANALOG1	Input	20-16	-	
6	DIGITAL INPUT 1	Input	20-16	-	
7	HS_OUT	High side Output	20-16	Generic high side output 200mA.	
8	Vaux+	Power	20-16	Positive power wire of the MCU. Must be connected to the auxiliary battery using fuse type.	
9	CAN1L	Communication	20-16	Low level of differential signal CAN1.	
10	CAN2H	Communication	20-16	High level of differential signal CAN2.	
11	5V SENSOR	Analog supply	20-16	-	
12	PWM2_OUT	Low side output	20-16	Generic Low side Output 1A, can be used as PWM.	
13	ANALOG3	Input	20-16	-	
14	DIGITAL INPUT 3	Input	20-16	-	
15	Vaux+	Power	20-16	Positive power wire of the MCU. Must be connected to the auxiliary battery using fuse type.	
16	CAN1H	Communication	20-16	High level of differential signal CAN1.	
17	GND_SENSORS	Ground	20-16	-	
18	HVIL_IN	HVIL IN	20-16	Hazardous voltage interlock loop (200mA max).	
19	HVIL_OUT	HVIL OUT	20-16	Hazardous voltage interlock loop (200mA max).	
20	ANALOG2	Input	20-16	-	
21	DIGITAL INPUT 2	Input	20-16	-	
22	Vaux-	Reference	20-16	Must be connected to the vehicle chassis (frame/auxiliary battery -).	
23	Vaux-	Reference	20-16	Must be connected to the vehicle chassis (frame/auxiliary battery -).	

Type 1 connector
The communication connector has 12 pins with the following specification:
VMU/ECU interface harness – Plug pinout specifications – P770E0106 (Type1)

PIN	Signal Name	Types	AWG	Description
A	CAN1L	Communication	20-22	Low level of differential signal CAN1.
B	CAN1H	Communication	20-22	High level of differential signal CAN1.
C	CAN2L	Communication	20-22	Low level of differential signal CAN2.
D	CAN2H	Communication	20-22	High level of differential signal CAN2.
E	Vaux+	Power	20-22	Positive power wire of the MCU. Must be connected to the auxiliary battery using fuse type.
F	Vaux+	Power	20-22	Positive power wire of the MCU. Must be connected to the auxiliary battery using fuse type.
G	Ignition	Input	20-22	Enable signal to the Motor Control Unit.
H	Emergency stop	Output	20-22	Emergency stop.
J	HVIL_IN	HVIL IN	20-22	Hazardous voltage interlock loop (200mA max).
K	HVIL_OUT	HVIL OUT	20-22	Hazardous voltage interlock loop (200mA max).
L	Vaux-	Reference	20-22	Must be connected to the vehicle chassis (frame/auxiliary battery -).
M	Vaux-	Reference	20-22	Must be connected to the vehicle chassis (frame/auxiliary battery -).

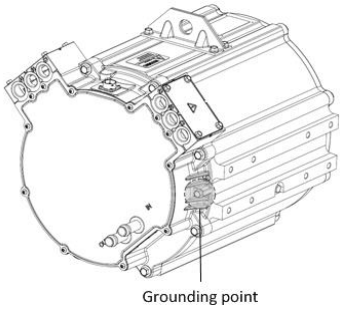


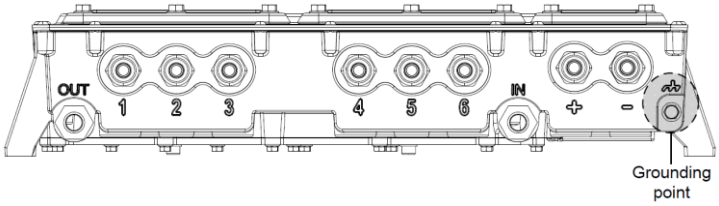
Grounding Point

The grounding point connection prevents functional issue to the motorization system, and ensures the user safety in case of an insulation fault. An incorrectly grounded connection may result in functionality losses and safety risks for the user. Grounding straps must be connected to their dedicated connection points (on the MCU and the motor) to the vehicle chassis frame.

The vehicle chassis connection points for the MCU and motor grounding straps should ideally be the same point, or the same vehicle chassis frame side. Conductive grease should be used on each of the contact points to ensure reliable and durable grounding connections. The resistance between the grounding points and the chassis must be tested each time the connection is impacted. The resistance must be less than 0.1 Ohm.

MCU and motor grounding point locations (product type example)

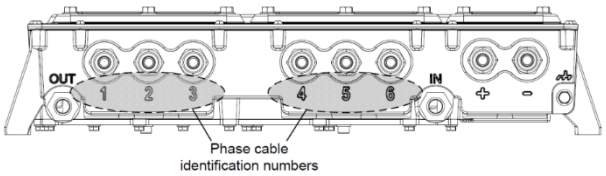




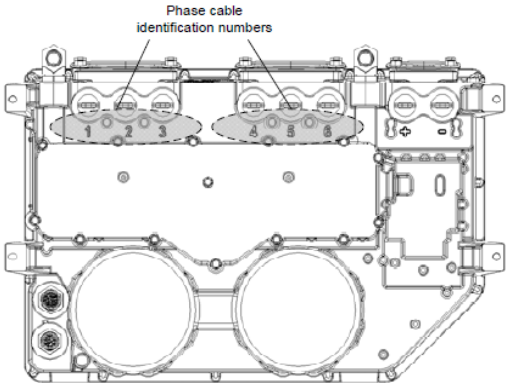
Motor Phase Connectors

Power cables are required between the MCU and the motor to connect each phase. An example of a product with a view of the phase cable connection points is shown below.

Phase Cable Identification (Straight Terminal)



Phase Cable Identification (90 degrees)

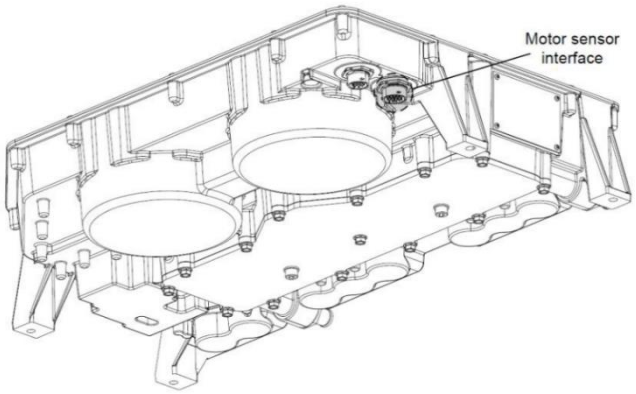


Motor Sensor Cables

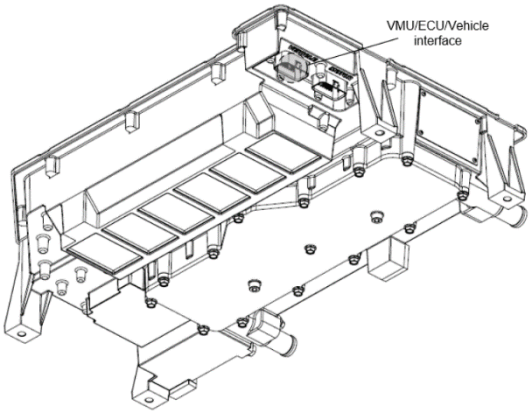
The Motor and the MCU must be connected together by motor sensor cables. Therefore, a motor sensor interface harness is required between the motor and the MCU.

Motor sensor connector pinout mapping from Dana TM4 MCU to TM4 motors

MCU Type 1	MCU Type 2	Signal name	TM4 Motor Type 1	TM4 Motor Type 2
A	1	Temperature C-	A	F3
B	9	Temperature C+	B	F2
C	16	Temperature B-	C	A3
D	2	Temperature B+	D	A2
E	10	Temperature A-	E	A4
F	17	Temperature A+	F	B4
J	3	R1_OUT	N	A1
T	11	R2_OUT	P	B1
L	18	COS+ (S1)	L	C1
M	4	COS- (S3)	M	D1
N	12	SIN+ (S2)	J	E1
P	19	SIN- (S4)	T	F1
H	5	HVIL_TO_MOTOR	H	F4
R	13	1 Wire OUT	R	C2
S	20	1 Wire GROUND	S	C3
K	6	HVIL_FROM_MOTOR	K	E4
V	N/C	Chassis	V	N/C



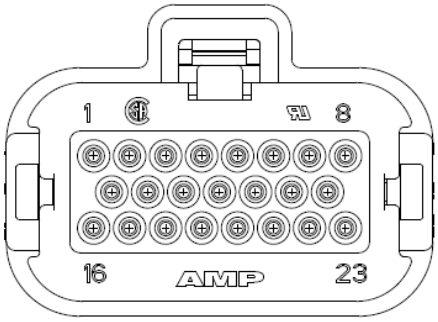
MCU connector type 1



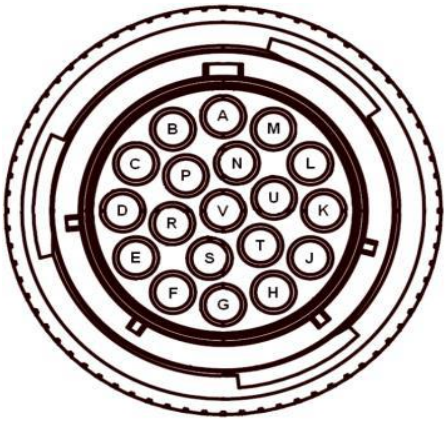
MCU connector type 2

Motor connector head Identification

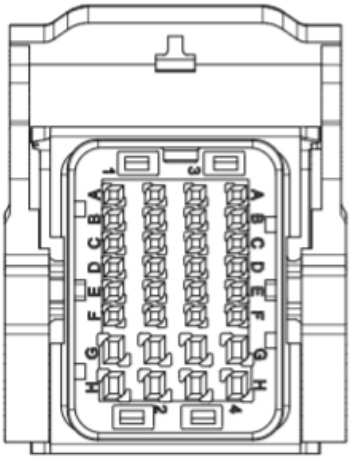
Dana TM4 MCU A3 (Type 2)



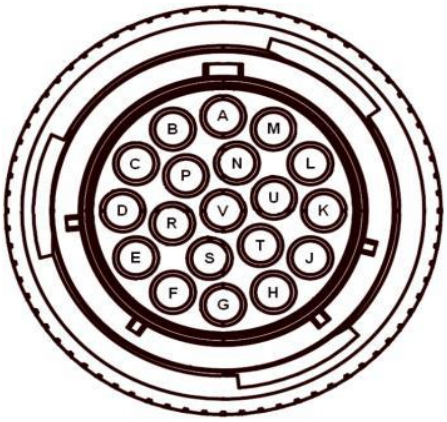
Dana TM4 MCU A1/A2 (Type 1)



Dana TM4 Motor (Type 2)



Dana TM4 motor (Type 1)

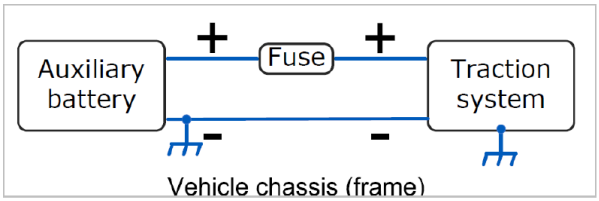


Connecting Auxiliary Battery to MCU

The Auxiliary Battery provides power to the MCU. The negative terminal of the battery must be connected to the frame of the vehicle (chassis).

Auxiliary Battery Fuse

To protect the system against short circuit, a fuse is connected in series with the positive terminal of the auxiliary battery.



Specifications	Units	Values (12 V)	Values (24 V)
Maximum MCU steady state current	A	4.5	3
Maximum MCU inrush current	A	< 10	< 10
Maximum MCU quiescent current	mA	< 1	< 1.5

Note: Refer to the Installation guide for further details.

Embedded software packages

The software installation package includes several embedded files:

- The embedded software package executable
- A basic TM4 ODIN file (.odn4).

The next chart shows the embedded software package files:

File	Name	Description
Embedded Software Package Executable	MCU_INV- *ABCDEFGH* Pkg.exe (See note on software PACKAGE naming)	Embedded software files used for firmware update.
Basic TM4 ODIN file (Part of the embedded software package accessible with TM4 ODIN)	UserInterface.odn4	Basic file used within TM4 ODIN to see software variables.

Note on software package naming
A---------- IGBT technology ex. HP2
B---------- Operating voltage type (L, M or H) ex. HV
C---------- Number of 3 phase systems with number of phases ex. 0206
D---------- Software develop by ex. TM4
E---------- Motor type ex MO340
F---------- Motor size ex. 240
G ---------- Software family letter ex. A
H---------- Software version (Major, minor, delivery and change list) ex. 3.6.1.95366

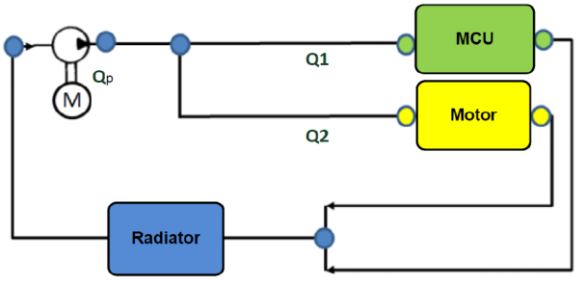
As an example, here is a typical software package file name:
MCU_INVHP2HV_0206_TM4_MO340_240_A_V3.6.1.95366Pkg.exe

Coolant In / Out

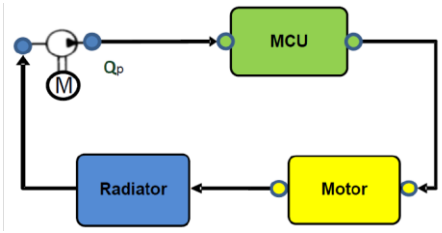
As power is delivered to the wheels, temperatures of the various components within the motor and the MCU rise. Therefore, a cooling unit/radiator must be installed in the vehicle and connected to the MCU and the motor to dissipate the excess heat.

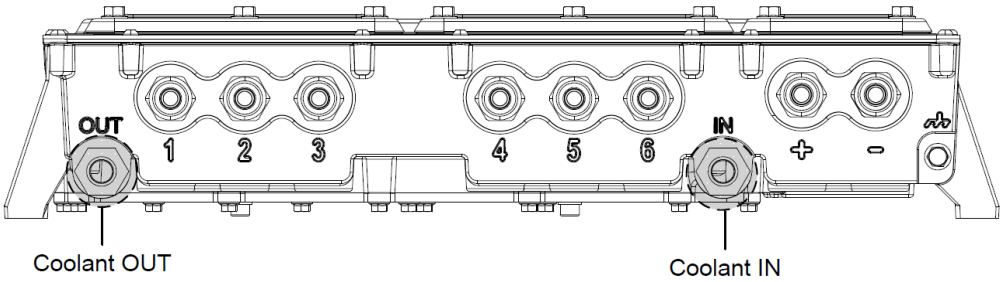
The motor and the MCU are linked to the cooling system by a fan/pump/coolant tank and radiator configuration. There are two possible configurations for the cooling system: the parallel configuration and serial configuration.

Parallel Configuration



Serial Configuration





MCU example with coolant inlet and outlet indications

Coolant Specification

Safety precaution

⚠ WARNING

Regardless of the cooling system used, the product can be damaged if the coolant temperature is allowed to exceed the maximum temperature specified in your system specifications document. The MCU will apply a derating mode as a protection to reduce the system's heat generation.

Also, the static pressure of the coolant system should never be allowed to exceed 30 PSI. Doing so, may overcome internal sealing breach and cause damages to the unit:

- Ensure that the cooling system components are adjusted correctly to respect these limits.

Recommendations

To prevent corrosion in cooling systems, these recommended best practices must be followed.

- The cooling circuit must be rinsed with de-ionized water each time before filling.
- The ethylene glycol must respect the standard corresponding to its application (ASTM D3306 Type III or ASTM D6210 Type III).
- The ethylene glycol must contain some type of active corrosion inhibitors.
- The ethylene glycol must be diluted with de-ionized water (not distilled water).
- The dilution ratio must be 60% ethylene glycol to 40% de-ionized water (minimally 50% ethylene glycol to 50% de-ionized water).
- Two different types of coolant should not be mixed.

As the cooling unit, cooling hose and cooling agent are not supplied by Dana TM4, the vehicle integrator has full responsibility for following specifications and operating methods given by the system specifications and the provided products interface drawings (MCU and motor).

In order to meet Dana TM4 specifications and to obtain maximum system performance, the temperature of the coolant and coolant flow must comply with the requirements as specified in the system specifications of your system. Above these thresholds, the system can degrade the output torque to protect its internal components from overheating.

When using the MCU in a vehicle cooling configuration, there can be associated drops in pressure that have to be managed. Coolant pressure drops can be affected by the temperature of each component; refer to your system's specifications for more information.

⚠ WARNING

User security:

- Ensure that each cable is clearly identified for specific usage to prevent errors during installation and operation that may damage the system or cause injury to the user.
- Ensure that, once installed, cables do not obscure any warning labels on the product.

When installing:

- Ensure cable bending radius of x5 of the cable diameter or greater. A correctly installed cable should be smooth with no creases or signs of strain that might eventually compromise cable integrity.
- Ensure that cables do not touch or cross over each other.
- Never place cables near sharp edges or on abrasive surfaces.
- Protect cables from damage due to gravel or other environmental factors.

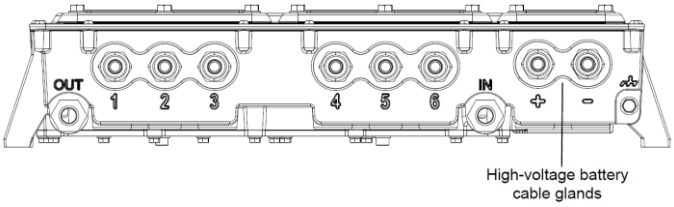
Allow for enough room for air circulation, clearance space for movement and access to cables for maintenance etc.

When securing cables:

- Ensure that each cable is appropriately supported (connector strain relief):
- High-voltage cables – secured no more than 10 cm from the connectors.
- Low-voltage cables – secured no more than 30 cm from the connectors.
- To restrict movement and vibration in longer cables, a maximum of 3 cables should be fastened together in parallel every 40 cm or less; do not gather cables in a tight bundle.
- Ensure that the brackets/fasteners used to support/secure the cables do not compromise cable integrity.
- Never apply perpendicular loads on the connectors/cables when using cable fasteners as this could compromise ingress protection (i.e. IP6K9K).

High Voltage Battery Terminal

The figures below show an example of an MCU cable gland where the High Voltage battery (Traction Battery) is connected.



High-voltage Battery Pre-Charge Circuit

The high-voltage battery must be connected to the MCU using specific cable assemblies. The table below is an example for the cable specifications. Refer to the MCU installation guide for the cable specifications.

Important Note: It is absolutely necessary to regard the safety precautions for the High Voltage Battery before connecting the High Voltage Cables.

The chart below is an example of the specifications available. Other system can be used with different wire size.

High Voltage Battery Short Circuit Protection

The MCU requires a fuse on the High Voltage DC bus. Proper fuse rating is necessary to protect against reverse polarity and short-circuit. Dana TM4 recommends installing a fuse with the following characteristics:
The table below is an example.

		Values	
Specifications	**Units**	**CO200-MV-A1**	**CO200-HV-A1**
Minimum fuse voltage rating	V_{dc}	650	1200
Rated current	A_{dc}	380	350
Maximum current	A_{dc}	650	650
Recommended fuse type	-	Fast-blow	Fast-blow

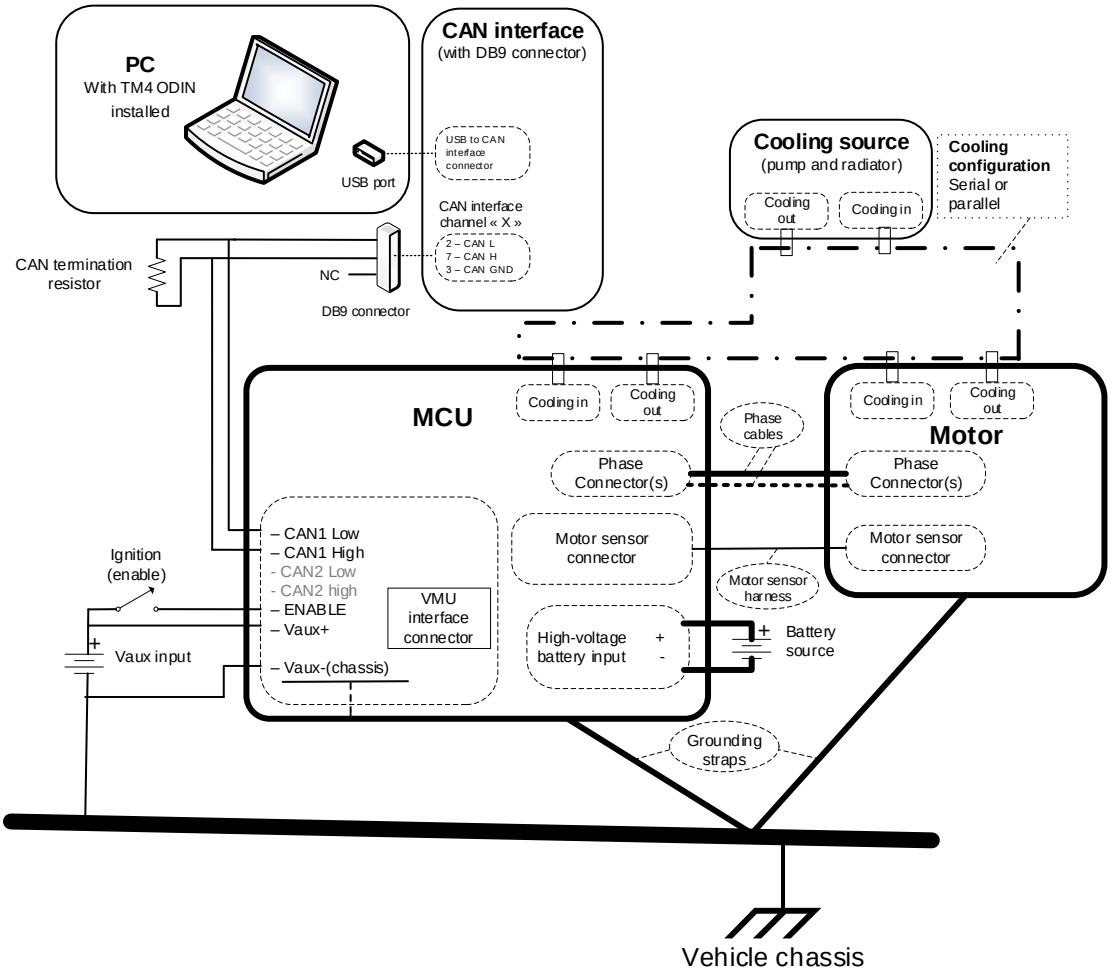
Refer to the "Application Note - TM4 SUMO Fuse and DC Cable Selection" published on the "Knowledge base" section of the Dana TM4 extranet site for proper fuse selection.

Specifications	Units	Values	Notes**
Wire size	AWG	1/0	1
Material	-	Under-hood contaminant resistant	1, 2
Voltage	V	Depends on high-voltage battery voltage	
Continuous current rating	A	340	3
Temperature rating	°C	150	
Colour	-	Orange	4
Shielded	-	Yes – Mandatory	5

Notes**:

1. The wire size or wire wall material can be adapted to fit required use.
2. Depending on the location of the wires, a wire tubing (orange split loom) can be used to prevent abrasion or other effects that could damage the wires.
3. Based on a temperature of 85 °C.
4. The color orange is recommended for safety purposes when handling high voltage levels.
5. The external cables used for high-voltage are be orange and shielded.

Simplified System Schematic



Legends

———	Electrical connections
▬ ▬ ▬	Electrical power connections
— · —	Coolant circuit
- - - - - -	Communication/control connection

Diagnostics

This section covers the equipment and procedures used to diagnose the system.

Diagnostics Tool

TM4 ODIN Tool

All Events are recorded in the SysFile and can be viewed using the TM4 ODIN diagnostic tool. Events categorized as Errors are dysfunctional event and cause the product to cease operation. Warnings and Information level events are also registered. Some warnings could require to be addressed even though the system remains operational.

Requirements

There are a number of required Files and Tools in order to use the TM4 ODIN tool correctly:

- PC with Windows 10 (Windows 7, 8 with limited access).
- Software extraction .zip (7zip, WinRar…).

Note: Windows XP and lower version are no longer supported.

- Any of the supported CAN interfaces below:
  - Kvaser: USB cable interfaces.
  - PEAK System: PCAN-USB, PCAN-PCIe and PCAN-USB Pro interfaces.
  - Vector: Vector XL-Interface family, for example, CANcaseXL, CANboardXL, CANcardXLe and CANcardLe and the VN16XX series, are all supported by TM4 ODIN.
- Drivers appropriate to the CAN interface.
- Cable required to connect the CAN interface to the Dana TM4 product. CAN interface.
- Latest version of TM4 ODIN.

The latest version of TM4 ODIN can be downloaded from the Dana TM4 extranet:

https://extranet.tm4.com/

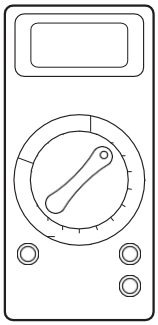
Note: Contact Dana TM4 if there is any issue during the installation or configuration of TM4 ODIN.

Note: We will refer the TM4 ODIN software by “ODIN”.

Multimeter

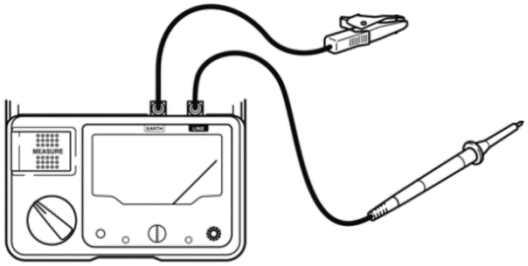
Based upon system schematics and aided by component-specific error messages, a multimeter is required to check continuity, resistance and voltage depending of the type of investigation conducted. The multimeter can be used to check:

- Continuity
- Effective Ground connection
- Broken wires
- Open circuits
- Shorted circuits
- Incorrect voltage level (high voltage battery or Vaux)



Megohmmeter

This device is used to measure the insulation of high voltage equipment or installation that may present a safety hazard in the event of a fault. The measurement is performed by generating a high DC voltage with a specific current magnitude. The result will be displayed in KΩ, MΩ or GΩ.



Installing the CAN drivers

Install all the CAN drivers provided with the CAN interface onto your computer.

Note: You must have ADMIN access rights on your Windows account to be able to install the CAN drivers and you may have to reinstall or configure the CAN drivers for each USB port you want to use.

Connecting the CAN ports

Connect the CAN ports of the CAN interface to the CAN port of the Dana TM4 product. Then connect the CAN interface to your computer.

You may need an adaptor depending on the CAN interface CAN box used.

The specific characteristics for the implementation of the CAN buses are described in the technical documentation for the Dana TM4 product you are using.

Note: CAN protocol supports parallel connections. It is possible to use a CAN interface connected to a PC that includes several CAN channels connected to different CAN bus at the same time or to connect only one CAN interface channel to a CAN bus.

Opening ODIN

“ODIN 4 Server 1” is preconfigured to communicate with a MCU product by default. “ODIN 4 Server 2” is preconfigured to communicate with a Dana TM4 NEURO (VMU) by default. The ODIN 4 Servers can be reconfigured to suit customer needs.

Retrieve the SysFile ID

Retrieve the GDD files

1. Power on the unit with the appropriate Auxiliary Vehicle Battery (Vaux) supply.
2. Turn the ignition ON for the MCU to be enabled.
3. Open Odin Server 1 and establish connection to the MCU.

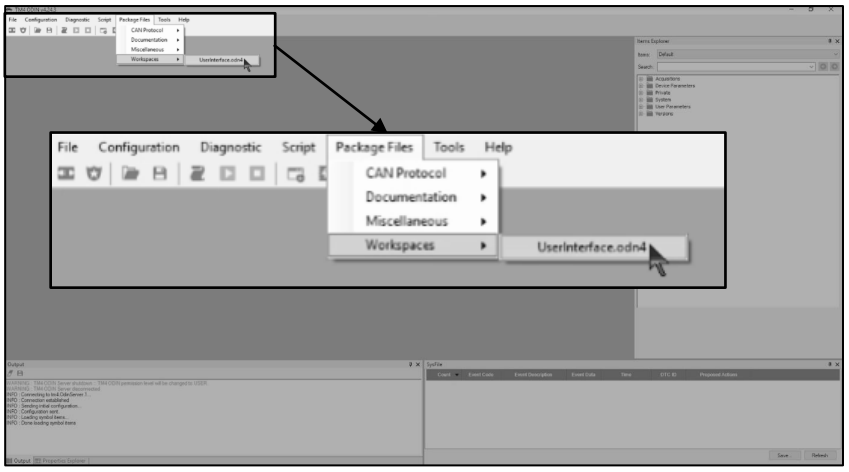
The Process description is in:

- Appendix 4 Retrieve GDD Files and User Parameters.

⚠ IMPORTANT

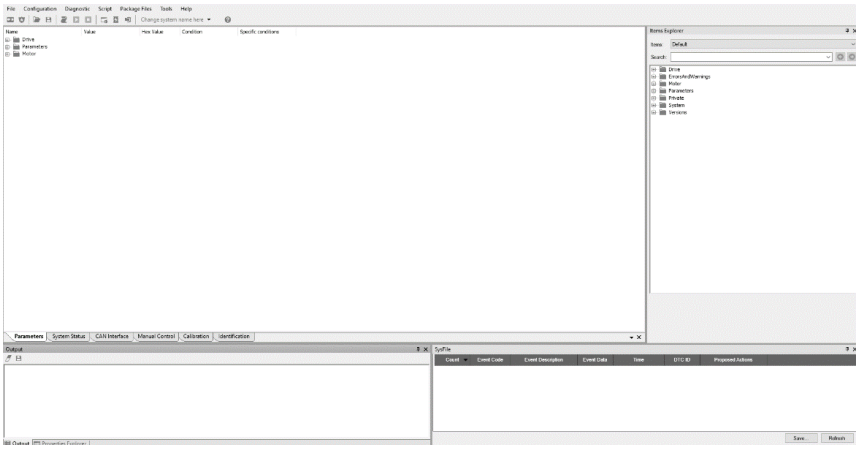
4. Make sure that at the bottom left of the Odin screen, « Device Connected » is displayed in green text.

5. In Odin Server 1, in the « Package Files » dropdown menu, select « Workspaces » and then, « UserInterface.odn4 ».



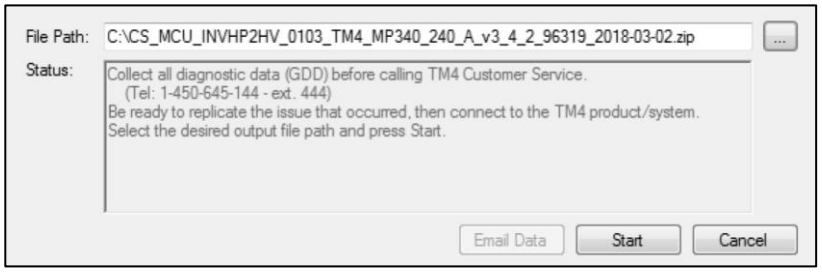
6. Wait until ODIN loads the following page.

Note: The following visual is an example. Other organization can be found has the software can be customized.



7. In the « Diagnostic » dropdown menu, select « GDD » or click the icon in the tool bar.

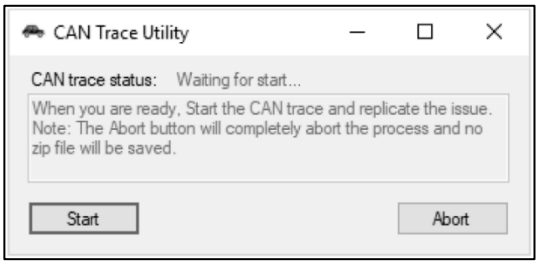
Note: GDD is also available and can be invoked if a CAN trace is required.



8. Click on ... and browse to the folder where the .zip file is created.

9. Click on the “Start” button to begin the process.

Note: If GDD was selected, a new window opens to begin the CAN trace recording.



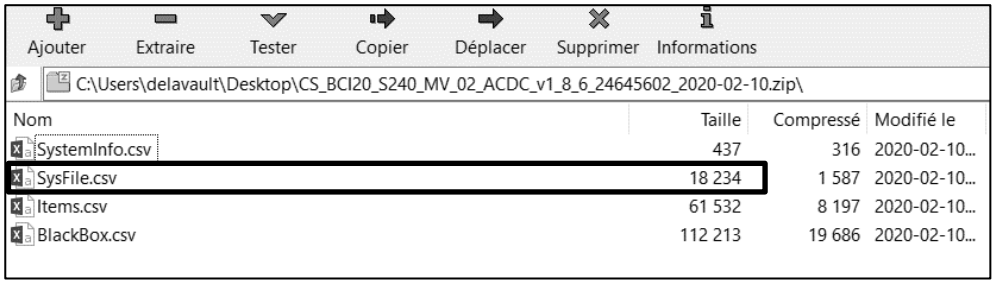
10. On the new window, click on the “Start” button (CAN trace recording start).

Note: The “Stop” button on the first window stops the CAN trace and gather the remaining information. At any time, you can click the “Abort” button on the second window to stop the process.

Once the data has been gathered, the “Email Data” button on the first window becomes available.
It generates an email with the .zip. Cancel can be selected to avoid sending an email with the data right away.

SysFile ID File

1. After retrieving the GDD .zip file, extract the file “SysFile.csv”.



2. Open the file.

1. **Count**: SysFile counter.
2. **Event Code**: SysFile ID.
3. **Event Description**: Brief description of the SysFile ID.
4. **Event Data**: This data gives precision about the cause of event.
5. **Time**: Amount of time before the Event Code occurs (starting from each unit power up).
6. **DTC ID**: Not used
7. **Purposed Actions**: Not used

NOTE: Adjust column width and row height in order to view all Proposed Actions.

1 Count	2 Event Code	3 Event Descri	4 Event Data	5 Time	6 DTC ID	7 Proposed Actions
632	0X4014	Warning - Cc	1	00:00:00	U0029-0x87	ACB2 Verify
633	0X4015	Warning - Cc	2	00:00:00	U0029-0x87	ACB2 Verify
634	0X051A	Warning - Se	0	00:00:09	0X0000-0x00	ANA No action related
635	0X051D	Info - Sequei	44487	00:00:09	0X0000-0x00	ANA No action related
636	0X051F	Info - Sequei	44487	00:00:10	0X0000-0x00	ANA No action related
637	0X3305	Info - Systen	44487	00:00:00	0X0000-0x00	ANA No action related
638	0X4012	Info - Com(	0	00:00:00	0X0000-0x00	ANA No action related
639	0X4014	Warning - Cc	1	00:00:00	U0029-0x87	ACB2 Verify
640	0X4015	Warning - Cc	2	00:00:00	U0029-0x87	ACB2 Verify
641	0X051A	Warning - Se	0	00:00:09	0X0000-0x00	ANA No action related
642	0X051D	Info - Sequei	44487	00:00:09	0X0000-0x00	ANA No action related
643	0X051F	Info - Sequei	44487	00:00:10	0X0000-0x00	ANA No action related
644	0X3305	Info - Systen	44487	00:00:00	0X0000-0x00	ANA No action related
645	0X4012	Info - Com(	0	00:00:00	0X0000-0x00	ANA No action related
646	0X4014	Warning - Cc	1	00:00:00	U0029-0x87	ACB2 Verify
647	0X4015	Warning - Cc	2	00:00:00	U0029-0x87	ACB2 Verify
648	0X051A	Warning - Se	0	00:00:09	0X0000-0x00	ANA No action related
649	0X051D	Info - Sequei	44487	00:00:09	0X0000-0x00	ANA No action related
650	0X051F	Info - Sequei	44487	00:00:10	0X0000-0x00	ANA No action related
651	0X3305	Info - Systen	44487	00:00:00	0X0000-0x00	ANA No action related
652	0X4012	Info - Com(	0	00:00:00	0X0000-0x00	ANA No action related
653	0X4014	Warning - Cc	1	00:00:00	U0029-0x87	ACB2 Verify

SysFile ID Summary

Note: In this document Service Code are named SysFile ID in accordance with ODIN TM4 convention.

SysFile ID are described in the Service Codes section. Some service codes identify the related system.

SysFile IDs are grouped by specific Event Categories; each SysFile ID has a unique ID and a type (Info, Warning or Error) along with a description. SysFile IDs are gathered in a Troubleshooting Tree that refer to a specific diagnostic tree.

Table of SysFile ID

The following table of the SysFile ID provides the in formation of the diagnostic type, the code description and the related Troubleshooting Tree (see the section **Appendix 1: Table of SysFile ID** Erreur ! Source du renvoi introuvable.in the Appendix section).

Table of Troubleshooting Tree

The table of Troubleshooting Tree provides the information of the:

- SysFile ID,
- Troubleshooting Tree number,
- Sub Troubleshooting Tree are included in some Troubleshooting Trees.

(see the section **Appendix 2: Table of Troubleshooting Trees** in the Appendix part).

Table matching SysFile IDs and Troubleshooting Trees

The following table relates the SysFile ID with the Troubleshooting Tree it belongs to.

SysFile ID	N° TT	SysFile ID	N° TT	SysFile ID	N° TT
0x0000	**01**	0x3201	**27**	0x4014	**35**
0x000A	**02**	0x3202	**27**	0x4015	**35**
0x0313	**03**	0x3203	**28**	0x4209	**02**
0x0314	**04**	0x3204	**27**	0x4703	**35**
0x0315	**05**	0x3205	**27**	0x4801	**05**
0x0316	**05**	0x3206	**27**	0x4B00	**05**
0x0319	**06**	0x3207	**28**	0x4B01	**05**
0x031A	**07**	0x3208	**27**	0x4B02	**05**
0x031B	**07**	0x3209	**27**	0x4B03	**05**
0x031C	**07**	0x320A	**27**	0x050B	**36**
0x031D	**08**	0x320B	**28**	0x050C	**36**
0x031E	**09**	0x320C	**29**	0x0506	**37**
0x031F	**10**	0x320D	**30**	0x0507	**37**
0x0320	**11**	0x320E	**31**	0x0508	**37**
0x0321	**05**	0x320F	**23**	0x0509	**37**
0x0322	**05**	0x3210	**32**	0x050A	**37**
0x0323	**05**	0x3211	**32**	0x050D	**37**
0x0324	**05**	0x3212	**13**		
0x0325	**05**	0x3301	**16**		
0x0326	**05**	0x3303	**33**		
0x0504	**12**	0x3307	**14**		
0x1000	**15**	0x3400	**05**		
0x1003	**16**	0x3401	**05**		
0x1100	**15**	0x3402	**05**		
0x1200	**15**	0x3403	**05**		
0x120A	**13**	0x3404	**05**		
0x1300	**02**	0x3405	**24**		
0x2200	**05**	0x3406	**05**		
0x2209	**14**	0x3407	**05**		
0x3100	**17**	0x3408	**05**		
0x3101	**17**	0x3500	**05**		
0x3102	**17**	0x4000	**25**		
0x3103	**17**	0x4001	**34**		
0x3104	**17**	0x4002	**34**		
0x3105	**17**	0x4003	**34**		
0x3106	**17**	0x4004	**34**		
0x3107	**17**	0x4005	**34**		
0x3108	**17**	0x4006	**34**		
0x3109	**05**	0x4007	**34**		
0x310A	**18**	0x4008	**34**		
0x310B	**19**	0x4009	**34**		
0x310C	**19**	0x400A	**34**		
0x310D	**20**	0x400B	**34**		
0x310E	**20**	0x400C	**34**		
0x310F	**21**	0x400D	**34**		
0x3110	**21**	0x400E	**34**		
0x3111	**25**	0x400F	**34**		
0x3112	**22**	0x4010	**34**		
0x3113	**26**	0x4011	**34**		
0x3200	**27**	0x4013	**35**		

Troubleshooting Tips

This checklist outlines some general hints and guidelines that will be helpful in tracking down and correcting operating problems.

☑ Systems not provided by Dana TM4 are not covered in this guide

Systems that are not provided or selected by Dana TM4 are not covered by this troubleshooting guide and might require use of additional external documentation.

☑ Calling after-sales services

This guide is meant to cover a dealership / garage level of troubleshooting. If the troubleshooting tree does not provide a solution to troubleshoot or solve an issue, it is highly recommended to consult after-sales services to continue troubleshooting.

☑ A cleared code alone does not indicate a corrected problem.

A service code is set by a specific fault condition and may be cleared by switching the ignition off, and then on. It’s possible to clear an error message only to have it display again when the fault condition reoccurs. To make sure an issue is fixed, be sure to run the system through the same operating modes that caused the issue and verify that the service code does not reappear.

☑ Electrical faults are often connection problems

The most likely cause of electrical faults will be damaged wires or connections. As a first step in troubleshooting all electrical codes, switch off vehicle ignition and make sure that the Vaux is disconnected, then disconnect applicable connectors and inspect for damage. (Switching off the ignition and Vaux is required before disconnecting the harness at the MCU but is also a recommended practice before all other electrical system disconnections.) Clean or repair all bad connections before proceeding.

Service Codes

Abbreviation and Definition

Abbreviation	Name	Description
TT	Troubleshooting Tree	Tree that allows to diagnose the possible cause of an error, warning or information message given by the unit.
STT	Sub Troubleshooting Tree	Develops a specific and routine part of the troubleshooting tree. It is used in multiple Troubleshooting Trees (TT).
SysFile ID	Service Codes = SysFile IDs	SysFile IDs are shown by software ODIN. They describe an error, warning or information message related to the unit.

Troubleshooting Trees Tables Details

System Mode	SysFile ID	Condition	Possible Causes
Functional state of the unit when the “Condition” (dysfunctional event) occurs.	List of the Service Code/SysFile ID related to the Troubleshooting Tree (TT).	Details the dysfunctional event that occurs on the unit.	List of the possible root causes that might be the source of the dysfunctional event (determined through the TT).

Troubleshooting Tree Legends

	Start & End	Indicates the beginning or end.
	External Process	Indicates a process not related to this unit. It may require a specific documentation related to the unit involved.
	Sub-tree	Indicates a sub-tree present in this document.
	Process/Actions	Indicates any process or action to do.
	Assistance Process	Indicates a process we describe an assistance action (Ex: “Call Dana TM4 for help”).
	Question/Decision/Choice	Indicates a decision point between two or more paths in the tree.
	Document	Indicates the document to refer for a dedicated action.

TT01: SysFile Cleared

System Mode	Referred by SysFile ID	Condition	Possible Causes
ReadyToPowerOff	0x0000	Indicates that the event list has been automatically cleared. Power off the Auxiliary vehicle battery without a “Ready to Power off CAN state” of the Motor Control Unit.	**1.** Wrong shutdown sequence. Auxiliary vehicle battery (Vaux) (12V or 24V) powered OFF before the MCU “Ready To Power OFF” CAN status on a shutdown sequence. **2.** Defective MCU.

MCU power off

The MCU shall indicate the status “ReadyToPowerOff” before disconnecting power from the Auxiliary vehicle battery (Vaux) via the CAN bus. If the power is switched off before this status this SysFile ID is raised. The SysFile will be cleared. The result is loss of all the SysFile IDs recorded in the MCU.
This SysFile ID means that the event log has been cleared.

Description

This SysFile ID is raised if the MCU is switch off before the “ReadyToPowerOff” state displayed.

It may be caused by a unit shut down where the MCU did not go into the “READYTOPOWEROFF” state.
It might also occur when the MCU is defective.

If SysFile section was corrupted, the SysFile is cleared. In this case, a followed warning (SysFile ID 0x000A) will indicate more detail upon nature of the clearance of the SysFile. See Subtree TT02.

Note: A manual SysFile reset by an advance user can also cause the SysFile to be cleared.

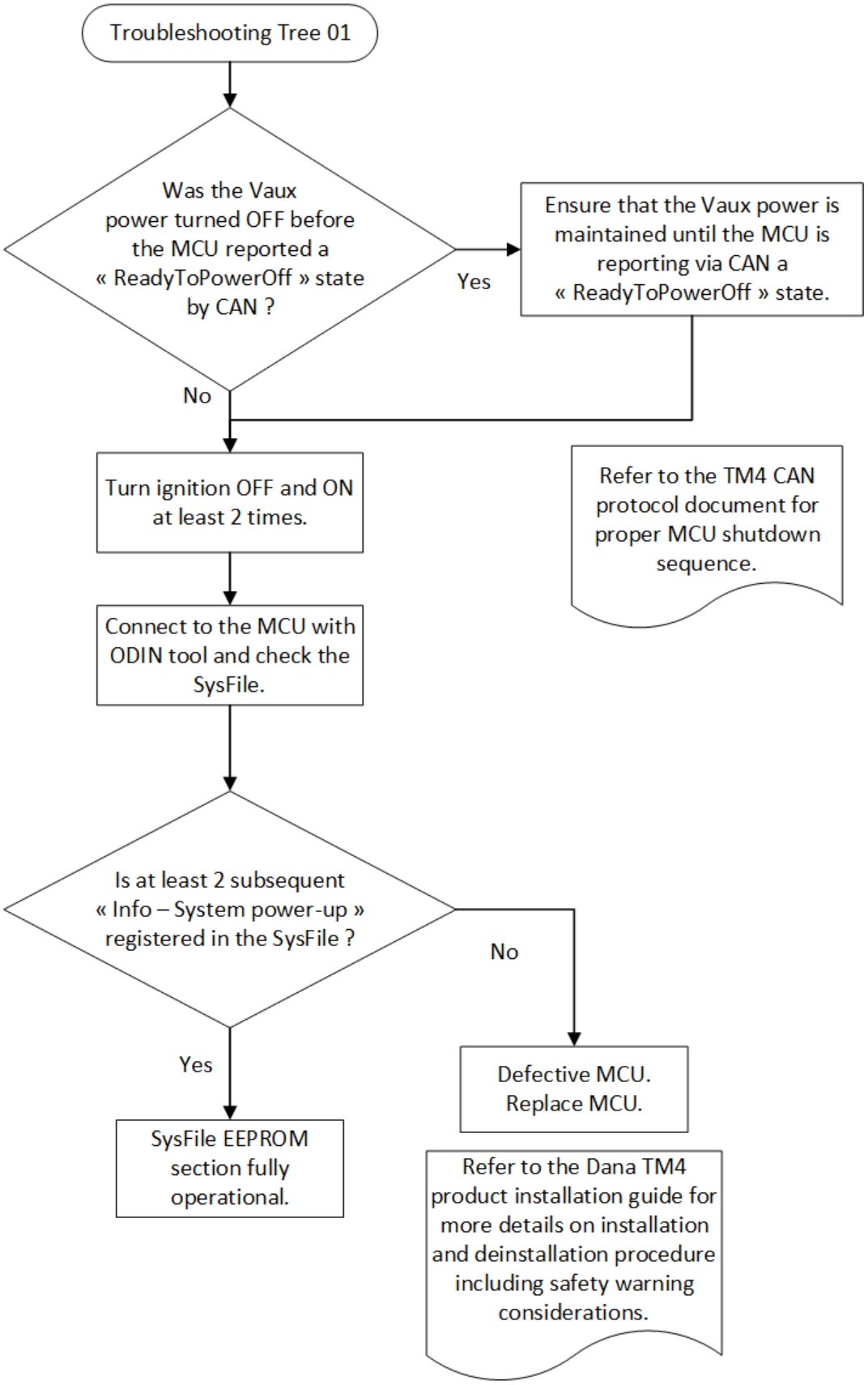
Note: On MCU shutdown sequence
The SysFile gets written in the unit EEPROM memory upon a shutdown sequence. If the Vaux power (12 V or 24 V) is removed before the MCU is in « ReadyToPowerOff » state via CAN, the SysFile section could possibly get corrupted and will be cleared on the next power ON.

Note: Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: Refer to the TM4 CAN protocol document for correct MCU shutdown sequence.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 01
Was the Vaux power turned OFF before the MCU reported a « ReadyToPowerOff » state by CAN ?
Yes
Ensure that the Vaux power is maintained until the MCU is reporting via CAN a « ReadyToPowerOff » state.
No
Refer to the TM4 CAN protocol document for proper MCU shutdown sequence.
Turn ignition OFF and ON at least 2 times.
Connect to the MCU with ODIN tool and check the SysFile.
Is at least 2 subsequent « Info – System power-up » registered in the SysFile ?
No
Yes
Defective MCU. Replace MCU.
SysFile EEPROM section fully operational.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT02: Inconsistence in EEPROM memory section

System Mode	Referred by SysFile ID	Condition	Possible Causes
Shutdown.	0x000A 0x1300 0x4209	MCU was shut down without reaching “ReadyToPowerOff” state.	**1.** Wrong shutdown sequence. Auxiliary vehicle battery (Vaux) (12V or 24V) powered OFF before the MCU “Ready To Power OFF” CAN status on a shutdown sequence. **2.** Defective MCU.

Description

This Troubleshooting Tree 02 indicates when MCU is started up and when it is shut down, and invalid data is recorded in the EEPROM. This is discovered through the verification known as Cyclic Redundancy Check (CRC), which detects whether a SysFile entry data is corrupted.

These SysFile IDs indicate a minor issue if other subsequent power-on are shown in the SysFile history.
It may also be caused by a unit shut down where the MCU did not go into the “READYTOPOWEROFF” state.
It is less likely that these SysFile IDs would result of a defective MCU.

Note:
- Vaux must be permanent through a fuse for a successful shutdown sequence.
- Corruption of EEPROM section may occur upon writing while power (Vaux) is removed.

Note: SysFile event log only shows one « Info – System power-up ».

Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

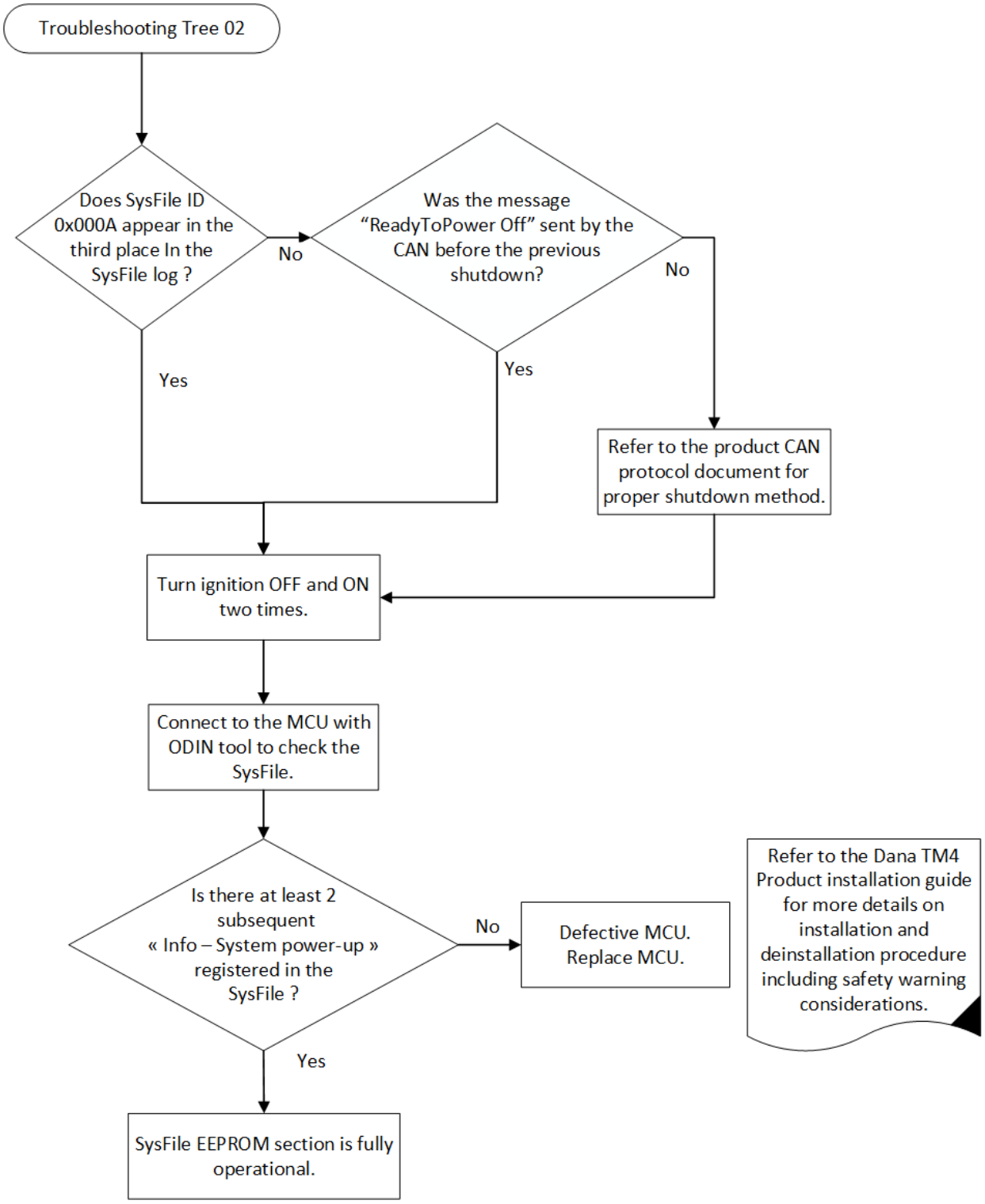
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Related Process

The TT02 call the following process:

- Appendix 3: Save EEPROM Sections.


Troubleshooting Tree 02
Does SysFile ID 0x000A appear in the third place In the SysFile log ?
No
Was the message "ReadyToPower Off" sent by the CAN before the previous shutdown?
No
Yes
Yes
Refer to the product CAN protocol document for proper shutdown method.
Turn ignition OFF and ON two times.
Connect to the MCU with ODIN tool to check the SysFile.
Is there at least 2 subsequent « Info – System power-up » registered in the SysFile ?
No
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Yes
SysFile EEPROM section is fully operational.

TT03: Vaux too low

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x0313	MCU detected an auxiliary vehicle battery voltage that was too low.	**1.** DCDC not regulating auxiliary DC voltage correctly. **2.** High auxiliary load being activated causing voltage drop. **3.** The auxiliary vehicle battery does not operate correctly. **4.** Intermittent or bad Vaux connection at the MCU. **5.** Vaux Fuse about to open or more resistive. **6.** Defective MCU.

Description

The Auxiliary vehicle battery voltage (Vaux) is the low voltage battery (12 V to 24 V) for providing power to the MCU.

This Troubleshooting Tree indicates that the voltage of the Vaux was lower than 7.5 V for at least 1 millisecond, which is the low limit for normal operation of the auxiliary vehicle battery. As this is only a warning, the system will still function as it displays this message.

The most likely cause of this warning is that the DCDC system is not regulating the auxiliary voltage correctly. It may be caused by the activation of another high auxiliary load.
The auxiliary vehicle battery itself may be defective.
There may be a bad connection between the auxiliary vehicle battery and the MCU. In this case, the user may require specialized equipment to diagnose this fault. This can be also that the Vaux Fuse about to open or more resistive.
The MCU itself may be defective.

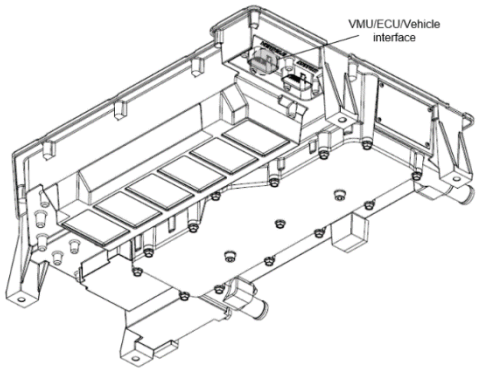
Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

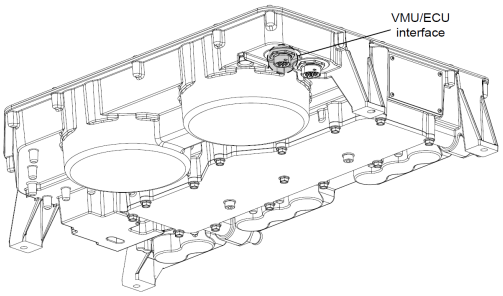
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

VMU Connector Head Identification

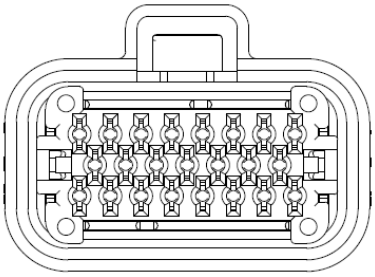
VMU/ECU Interface (Type 2)



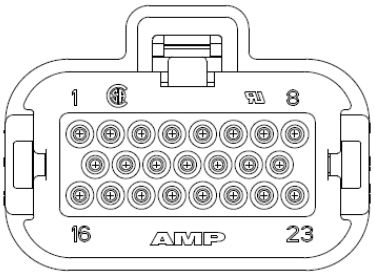
VMU/ECU Interface (Type 1)



VMU/ECU interface harness Plug Pinout (Type 2)

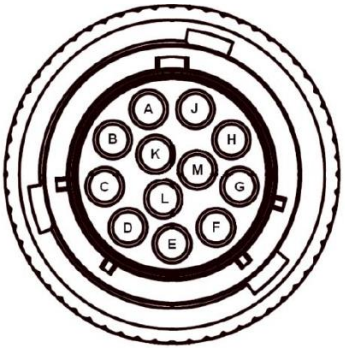


Connector (Front) (Type 2)

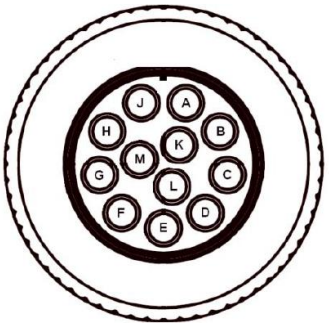


Wire Insertion Side (Back) (Type 2)

VMU/ECU interface harness Plug Pinout (Type1)



Connector (Front) (Type 1)



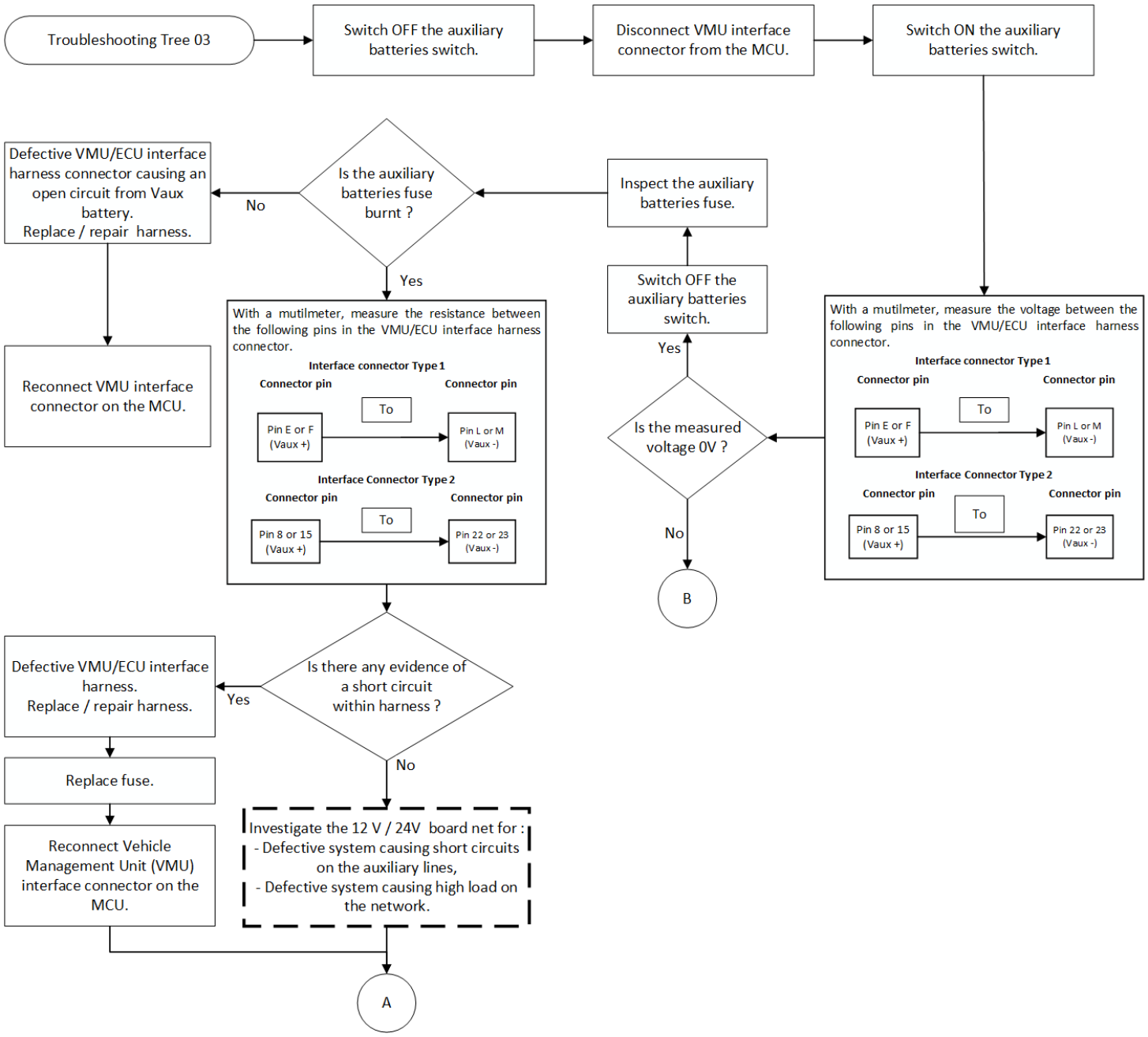
Wire Insertion Side (Back) (Type 1)

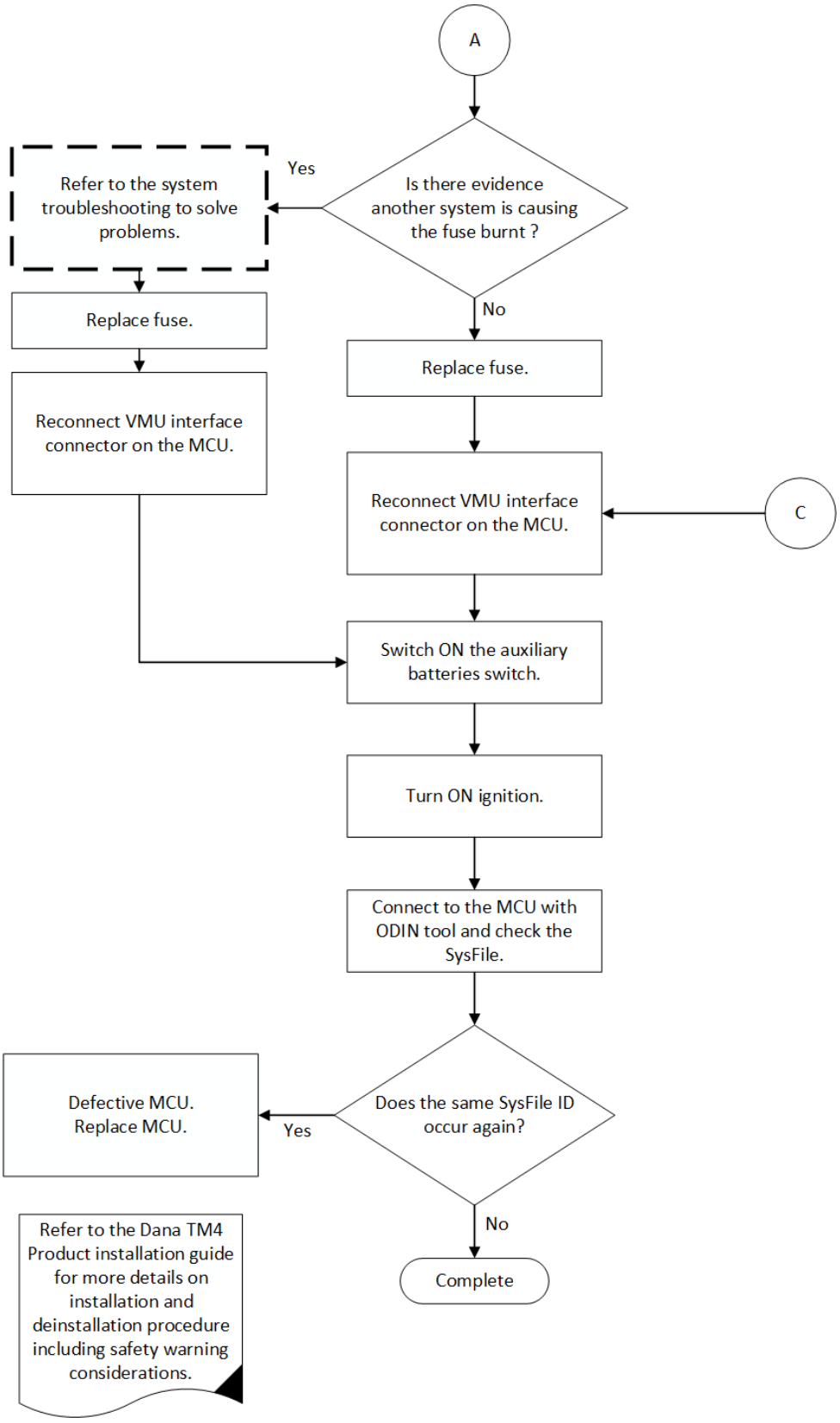
Connector type 2 pinout

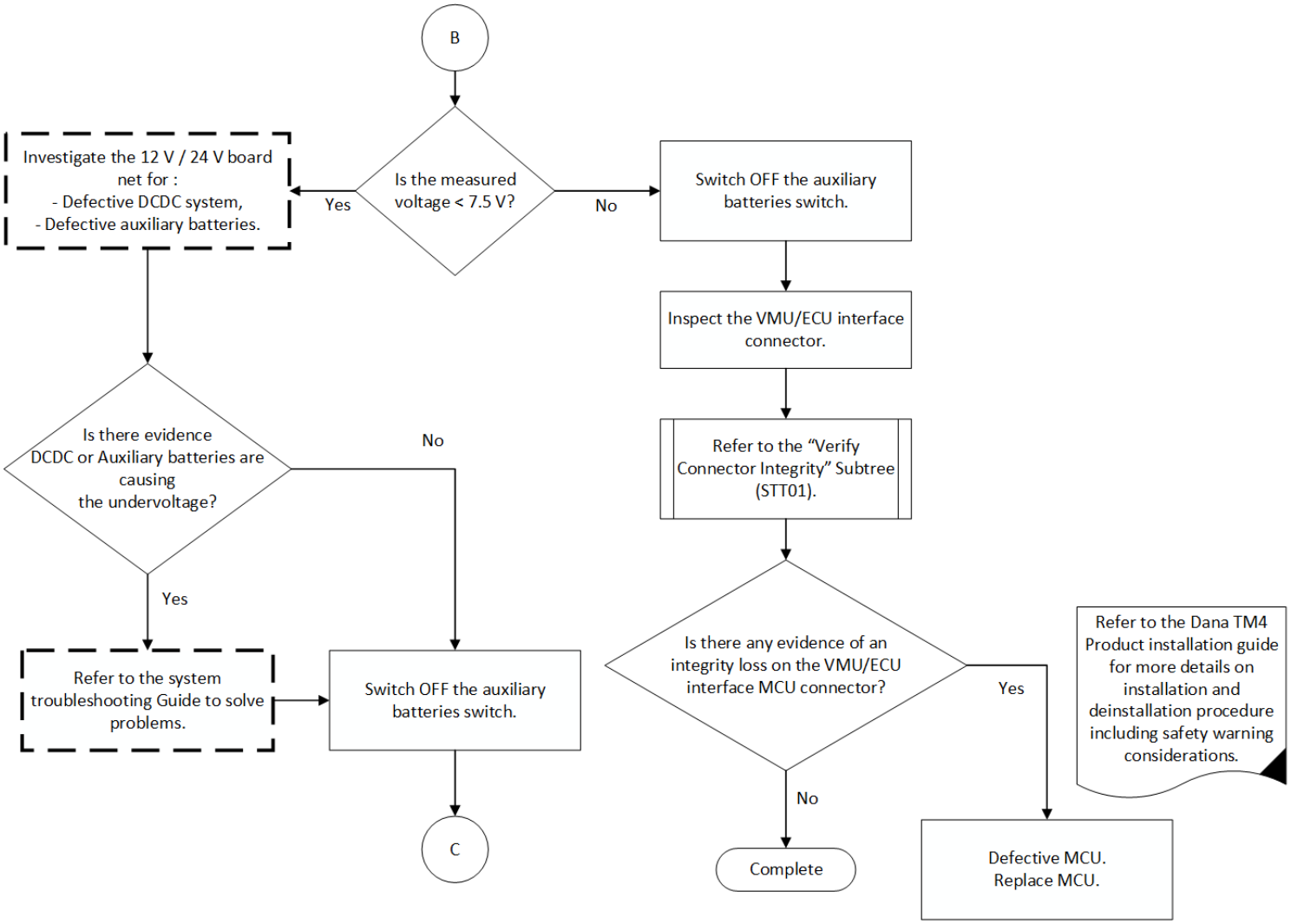
Pin	Signal names
15	V AUX +
8	
22	V AUX -
23	
1	IGNITION
9	CAN1L
16	CAN1H
2	CAN2L
10	CAN2H
18	HVIL_IN
19	HVIL_OUT
5	ANALOG1
13	ANALOG3
20	ANALOG2
6	DIGITAL INPUT 1
14	DIGITAL INPUT 3
21	DIGITAL INPUT 2
7	HS_OUT
17	GND_SENSORS
3	CAN SHIELD
11	5V_SENSOR
4	PWM1_OUT
12	PWM2_OUT

Connector type 1 pinout

Pin	Signal names
E	V AUX +
F	
L	V AUX -(Chassis)
M	
G	IGNITION
A	CAN1L
B	CAN1H
C	CAN2L
D	CAN2H
J	HVIL
K	HVIL
H	Emergency stop


Troubleshooting Tree 03
Switch OFF the auxiliary batteries switch.
Disconnect VMU interface connector from the MCU.
Switch ON the auxiliary batteries switch.
With a mutilmeter, measure the voltage between the following pins in the VMU/ECU interface harness connector.
Interface connector Type 1
Connector pin
Connector pin
Pin E or F (Vaux +)
To
Pin L or M (Vaux -)
Interface Connector Type 2
Connector pin
Connector pin
Pin 8 or 15 (Vaux +)
To
Pin 22 or 23 (Vaux -)
Is the measured voltage 0V ?
Yes
No
B
Switch OFF the auxiliary batteries switch.
Inspect the auxiliary batteries fuse.
Is the auxiliary batteries fuse burnt ?
No
Defective VMU/ECU interface harness connector causing an open circuit from Vaux battery.
Replace / repair harness.
Reconnect VMU interface connector on the MCU.
Yes
With a mutilmeter, measure the resistance between the following pins in the VMU/ECU interface harness connector.
Interface connector Type 1
Connector pin
Connector pin
Pin E or F (Vaux +)
To
Pin L or M (Vaux -)
Interface Connector Type 2
Connector pin
Connector pin
Pin 8 or 15 (Vaux +)
To
Pin 22 or 23 (Vaux -)
Is there any evidence of a short circuit within harness ?
Yes
Defective VMU/ECU interface harness.
Replace / repair harness.
Replace fuse.
Reconnect Vehicle Management Unit (VMU) interface connector on the MCU.
No
Investigate the 12 V / 24V board net for :
- Defective system causing short circuits on the auxiliary lines,
- Defective system causing high load on the network.
A


A
Is there evidence another system is causing the fuse burnt ?
Yes
Refer to the system troubleshooting to solve problems.
Replace fuse.
Reconnect VMU interface connector on the MCU.
No
Replace fuse.
Reconnect VMU interface connector on the MCU.
C
Switch ON the auxiliary batteries switch.
Turn ON ignition.
Connect to the MCU with ODIN tool and check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
No
Complete
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.


B
Is the measured voltage < 7.5 V?
Yes
No
Investigate the 12 V / 24 V board net for :
- Defective DCDC system,
- Defective auxiliary batteries.
Switch OFF the auxiliary batteries switch.
Inspect the VMU/ECU interface connector.
Refer to the "Verify Connector Integrity" Subtree (STT01).
Is there evidence DCDC or Auxiliary batteries are causing the undervoltage?
No
Yes
Refer to the system troubleshooting Guide to solve problems.
Switch OFF the auxiliary batteries switch.
C
Is there any evidence of an integrity loss on the VMU/ECU interface MCU connector?
Yes
No
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Complete
Defective MCU.
Replace MCU.

TT04: Vaux too high

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x0314	MCU detected an auxiliary voltage that was too high.	**1.** DCDC system not regulating auxiliary DC voltage correctly. **2.** Intermittent contact to the auxiliary vehicle battery that can cause voltage spikes due to load dump of the DCDC system. **3.** The auxiliary vehicle battery is not working properly. **4.** The MCU is defective.

Description

This Troubleshooting Tree indicates that the voltage of the auxiliary vehicle battery was higher than 33V for 1ms or more.

The most likely cause of the occurrence of this SysFile ID is that the DCDC voltage is not regulating the DC voltage correctly.
There may be intermittent contacts to the pins of the auxiliary vehicle battery.
The auxiliary vehicle battery itself may be defective. Specialized equipment may be need to determine this and fix the issue.
The MCU itself may be defective.

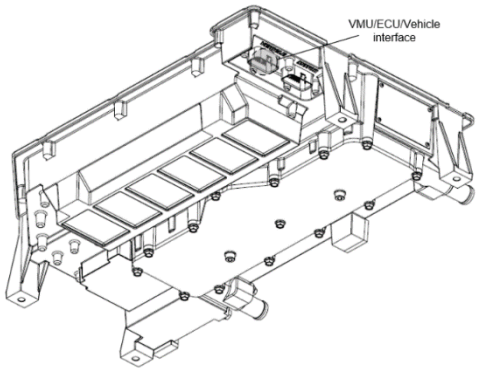
Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

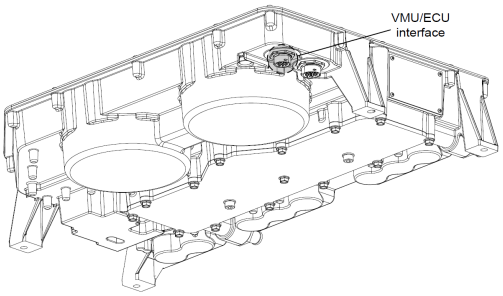
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Connector Head Identification

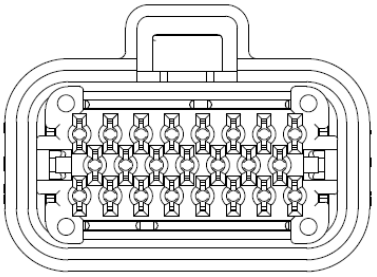
VMU/ECU Interface (Type 2)



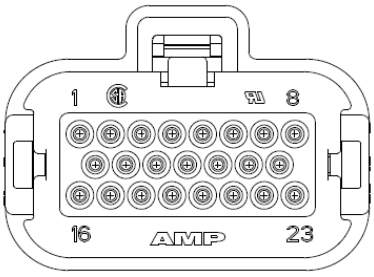
VMU/ECU Interface (Type 1)



VMU/ECU interface harness Plug Pinout (Type 2)

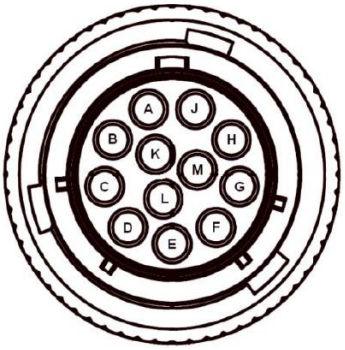


Connector (Front) (Type 2)

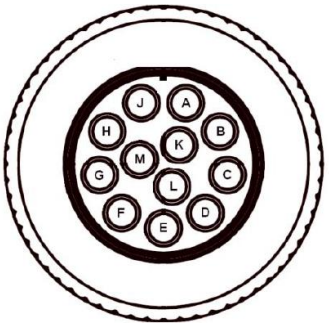


Wire Insertion Side (Back) (Type 2)

VMU/ECU interface harness Plug Pinout (Type1)



Connector (Front) (Type 1)



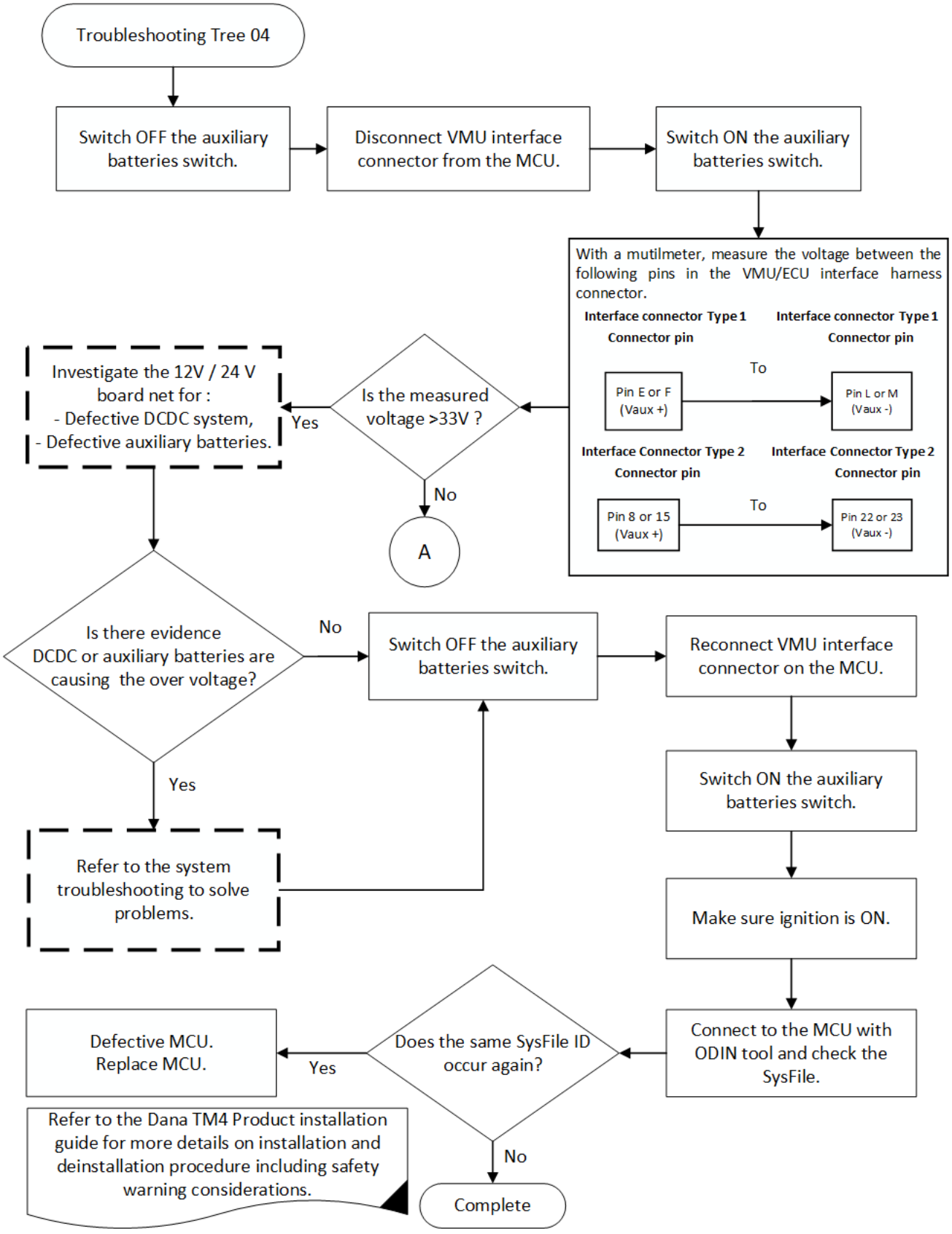
Wire Insertion Side (Back) (Type 1)

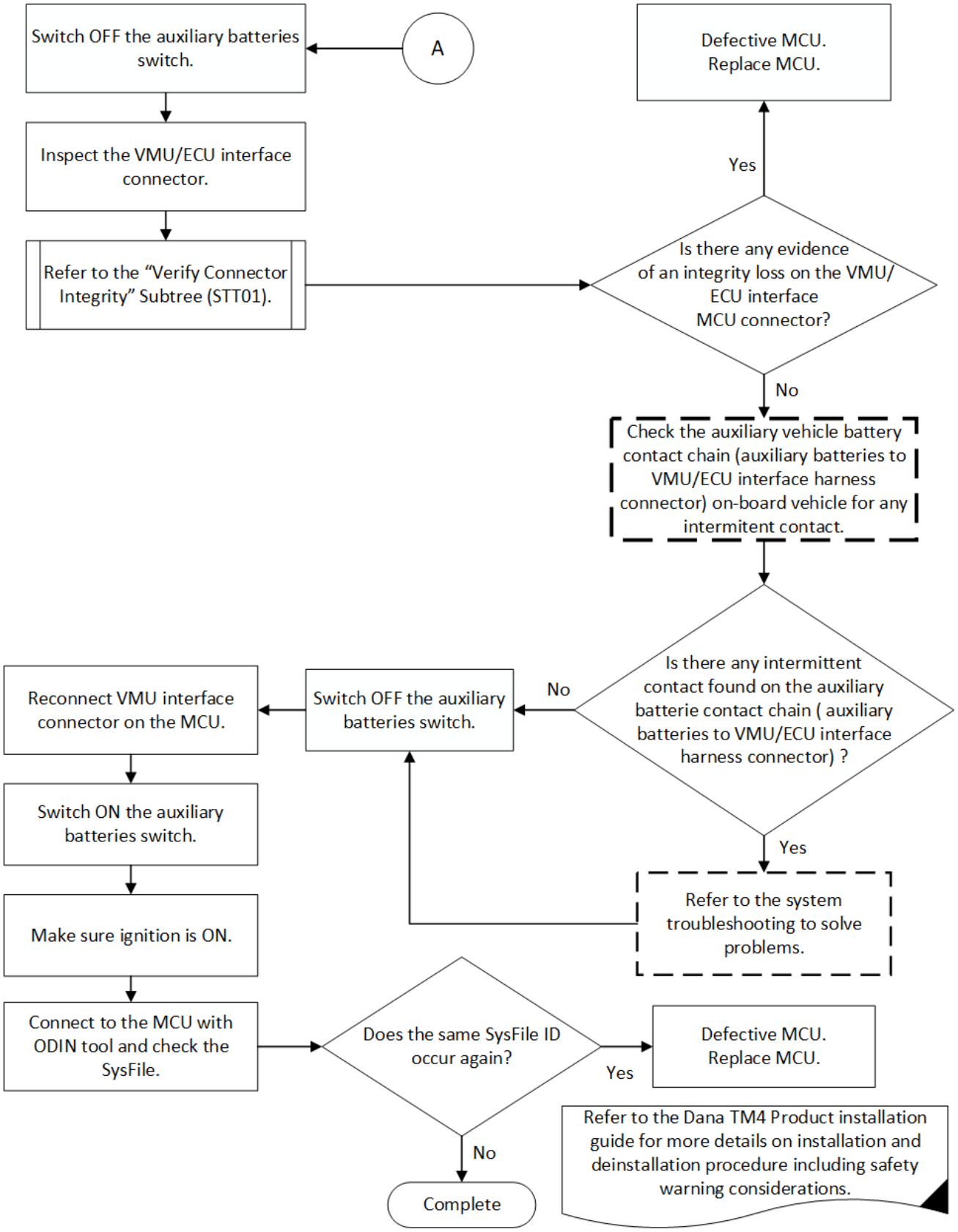
Connector type 2 pinout

Pin	Signal names
15	V^{AUX} +
8	
22	V^{AUX} -
23	
1	IGNITION
9	CAN1L
16	CAN1H
2	CAN2L
10	CAN2H
18	HVIL_IN
19	HVIL_OUT
5	ANALOG1
13	ANALOG3
20	ANALOG2
6	DIGITAL INPUT 1
14	DIGITAL INPUT 3
21	DIGITAL INPUT 2
7	HS_OUT
17	GND_SENSORS
3	CAN SHIELD
11	5V_SENSOR
4	PWM1_OUT
12	PWM2_OUT

Connector type 1 pinout

Pin	Signal names
E	V^{AUX} +
F	
L	V^{AUX} -(Chassis)
M	
G	IGNITION
A	CAN1L
B	CAN1H
C	CAN2L
D	CAN2H
J	HVIL
K	HVIL
H	Emergency stop


Troubleshooting Tree 04
Switch OFF the auxiliary batteries switch.
Disconnect VMU interface connector from the MCU.
Switch ON the auxiliary batteries switch.
With a mutilmeter, measure the voltage between the following pins in the VMU/ECU interface harness connector.
Interface connector Type 1 Connector pin
Interface connector Type 1 Connector pin
Pin E or F (Vaux +)
To
Pin L or M (Vaux -)
Interface Connector Type 2 Connector pin
Interface Connector Type 2 Connector pin
Pin 8 or 15 (Vaux +)
To
Pin 22 or 23 (Vaux -)
Is the measured voltage >33V ?
Yes
Investigate the 12V / 24 V board net for : - Defective DCDC system, - Defective auxiliary batteries.
No
A
Is there evidence DCDC or auxiliary batteries are causing the over voltage?
No
Switch OFF the auxiliary batteries switch.
Reconnect VMU interface connector on the MCU.
Switch ON the auxiliary batteries switch.
Yes
Refer to the system troubleshooting to solve problems.
Make sure ignition is ON.
Connect to the MCU with ODIN tool and check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
No
Complete


Switch OFF the auxiliary batteries switch.
A
Inspect the VMU/ECU interface connector.
Refer to the "Verify Connector Integrity" Subtree (STT01).
Defective MCU. Replace MCU.
Yes
Is there any evidence of an integrity loss on the VMU/ ECU interface MCU connector?
No
Check the auxiliary vehicle battery contact chain (auxiliary batteries to VMU/ECU interface harness connector) on-board vehicle for any intermitent contact.
Is there any intermittent contact found on the auxiliary batterie contact chain (auxiliary batteries to VMU/ECU interface harness connector) ?
No
Switch OFF the auxiliary batteries switch.
Reconnect VMU interface connector on the MCU.
Yes
Refer to the system troubleshooting to solve problems.
Switch ON the auxiliary batteries switch.
Make sure ignition is ON.
Connect to the MCU with ODIN tool and check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
No
Complete
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT05: Hardware Failure Detected

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x0315 0x0316 0x0321 0x0322 0x0323 0x0324 0x0325 0x0326 0x2200 0x3109 0x3400 0x3401 0x3402 0x3403 0x3404 0x3406 0x34070x3408 0x3500 0x4801 0x4B00 0x4B01 0X4B02 0x4B03	Internal hardware fault detection.	**1.** Some foreign material within the MCU or motor connector short some signals. **2.** MCU or motor connector pin is bent or broken. **3.** Motor sensor cable defective. **4.** Defective motor. **5.** Defective MCU.

Description

The Troubleshooting Tree 05 indicates that there is a hardware error that may cause the system to go to defective mode, whereby it will cease operation.

Components that may be the cause of the error are:

1. Motor Temperature sensors,
2. Resolver Chip,
3. Motor position sensor.

The resistance measurements of the resistance values of the related “Machine Internal Resistances” may not be aligned as per Machine internal resistance measurement table. The motor should be considered defective.

The loss of integrity of the motor sensor connector on the MCU leads to consider defective MCU.

Note: If the motor is a TM4 machine, then the expected values of the measurements should be between 10 Ohm and 5 kOhm. If the motor is not a TM4 machine, then the measurements may be different and refer to your machine specification.

Note: Refer to the TM4 motor installation guide for more details on installation and deinstallation procedure including safety warning considerations.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Machine internal resistance measurement table

Machine internal resistance measurements

Pin function	Expected resistance value (see note C)	Action to perform if measurement is not as expected
R1 & R2	Measured resistance value between 10Ω and 5KΩ	Change the machine (AMA1)
S1 & S3	Measured resistance value between 10Ω and 5KΩ	Change the machine (AMA1l)
S2 & S4	Measured resistance value between 10Ω and 5KΩ	Change the machine (AMA1)
Temp A- & Temp A+	See note D	Change the machine (AMA1)
Temp B- & Temp B+ (see note A)	See note D	Change the machine (AMA1)
Temp C- & Temp C+ (see note A)	See note D	Change the machine (AMA1)
Mot HVIL IN+ & Mot HVIL IN- (see note B)	Short circuit (close to 0Ω)	Change the machine (AMA1)
1Wire+ & 1Wire -	No measurement (see note E)	

Notes

A. The TM4 machine uses 3 thermal sensors and therefore the measurements should be taken on all 3 (A, B & C). Other machine types might only use 2 (A & B) or 1 (A).
Make sure you measure the thermal resistance according to the number of thermal resistance(s) used in the machine.
Refer to 3rd party integration documentation for more information on other machine types.

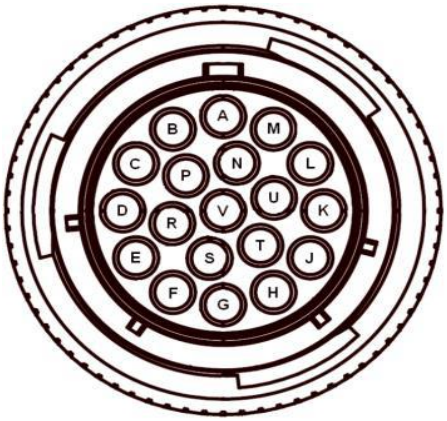
B. If the HVIL functionality is not used and therefore there is no short circuit provided between the HVIL pins inside the machine circuitry, skip this measurement.

C. All measurements should be taken at ambient temperature.

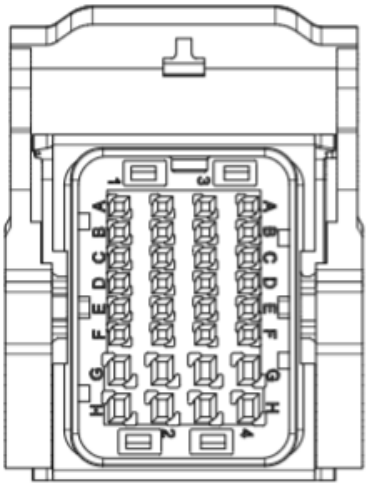
D. For a TM4 machine the measured resistance value should be between 10Ω and 5KΩ.
For the expected resistance value of all other machine types, refer to the 3rd party integration documentation.

E. There are no measurements to validate the functionality related to the 1 wire pins if they are used in the machine internal circuitry.
If this circuitry is used within the machine (as it is with a TM4 machine) a malfunction involving communication with the "One wire" circuitry inside the machine will record an event in the inverter SysFile (accessible using TM4 ODIN) registered as "Warning - One-Wire EEPROM Driver…". A SysFile code ID will also be sent related to that warning to the TM4 inverter product CAN bus by the message identified as either "McuOnEventInfo1" or "Mcu On Event 1".
If such an event is recorded in the inverter SysFile and sent to the TM4 inverter product CAN bus, change the machine. (AMA1).

Connector Head Identification

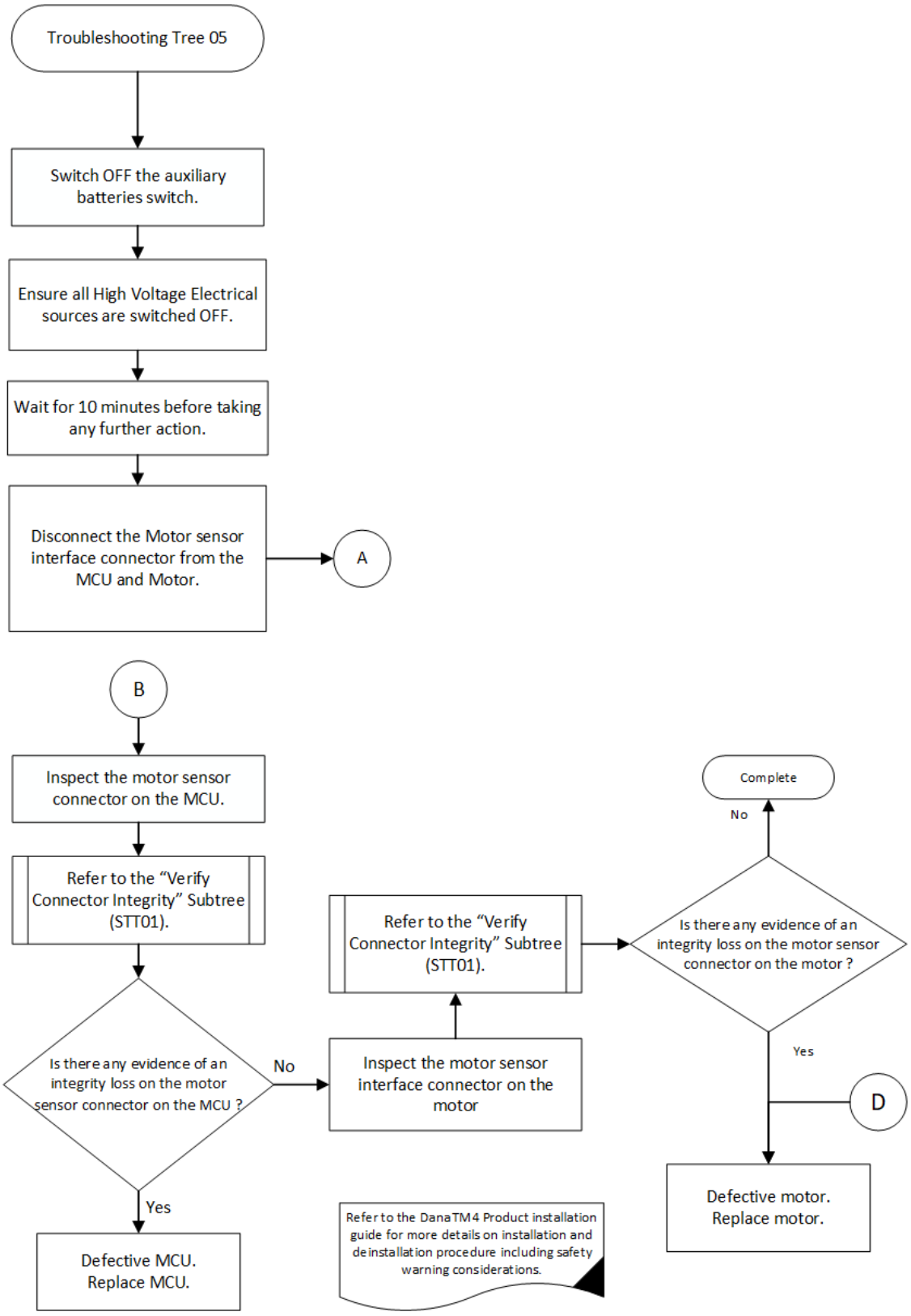


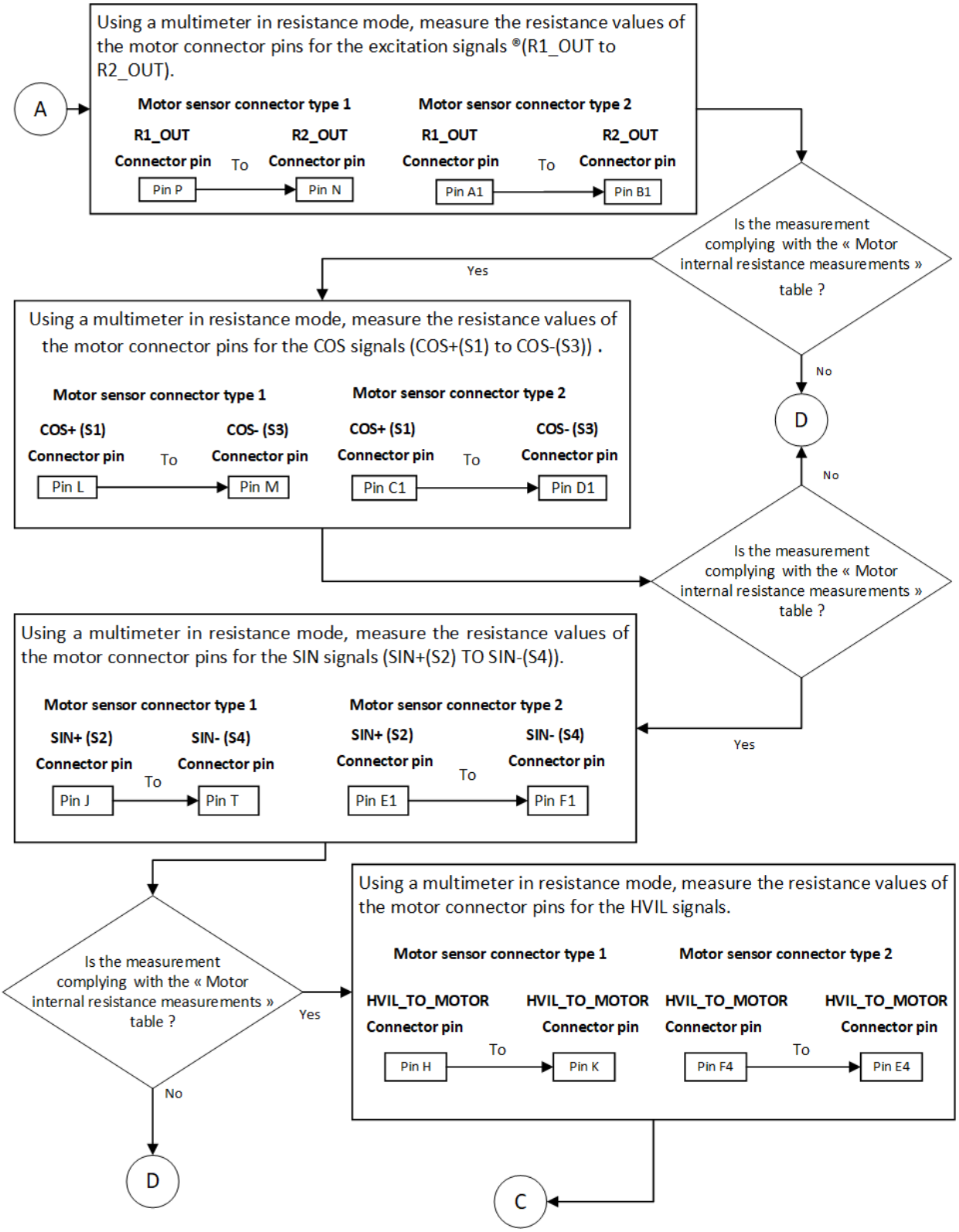
TM4 Motor connector (Type 1)

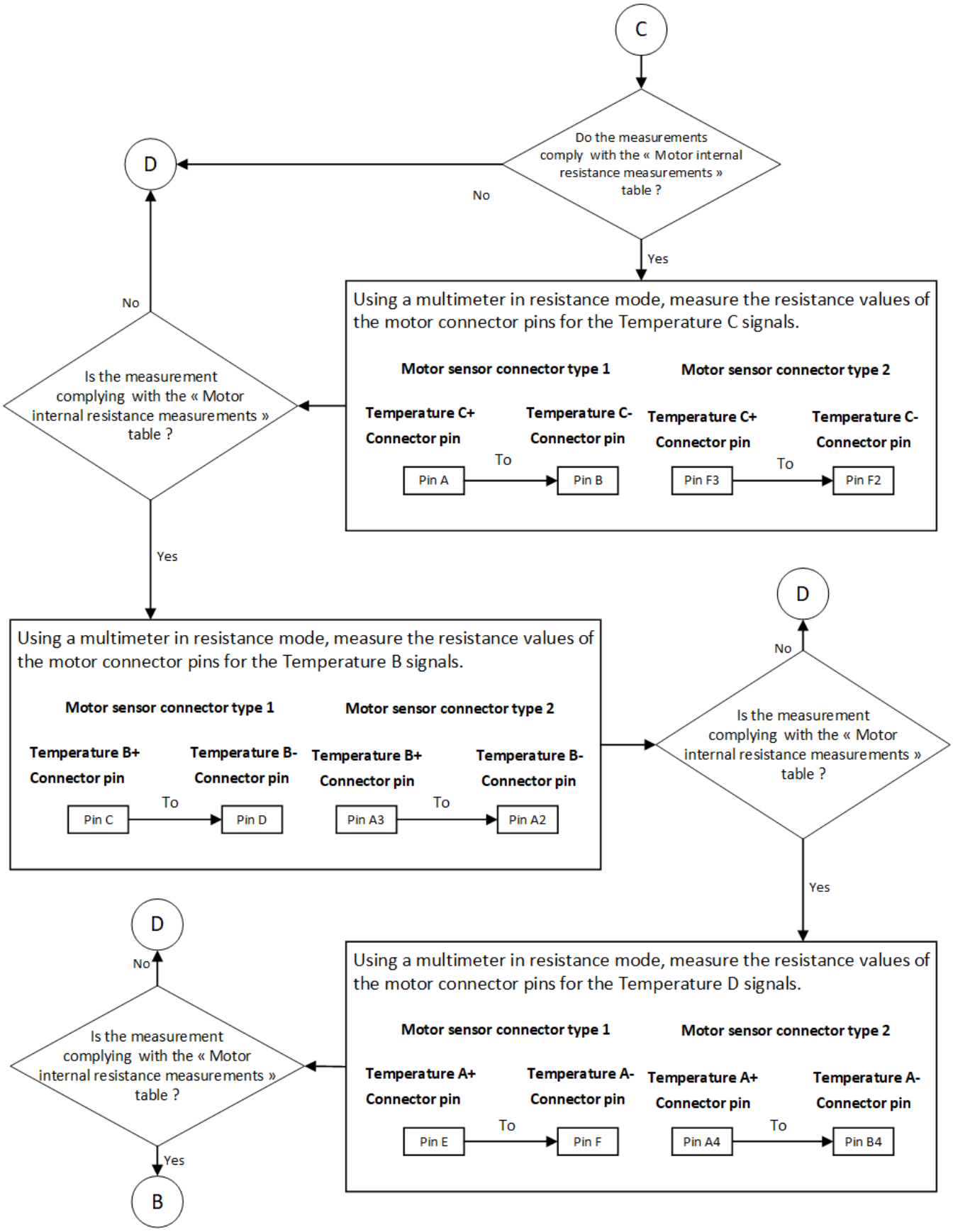


TM4 Motor connector (Type 2)

Signal name	TM4 Motor connector pinout Type 1	TM4 Motor connector pinout Type 2
Temperature C- Temperature C+	A B	F3 F2
Temperature B- Temperature B+	C D	A3 A2
Temperature A- Temperature A+	E F	A4 B4
R1_OUT R2_OUT	N P	A1 B1
COS+ (S1) COS- (S3)	L M	C1 D1
SIN+ (S2) SIN- (S4)	J T	E1 F1
HVIL_TO_MOTOR	H	F4
1 Wire OUT	R	C2
1 Wire GROUND	S	C3
HVIL_FROM_MOTOR	K	E4


Troubleshooting Tree 05
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Disconnect the Motor sensor interface connector from the MCU and Motor.
A
B
Inspect the motor sensor connector on the MCU.
Refer to the "Verify Connector Integrity" Subtree (STT01).
Is there any evidence of an integrity loss on the motor sensor connector on the MCU ?
No
Yes
Defective MCU. Replace MCU.
Inspect the motor sensor interface connector on the motor
Refer to the "Verify Connector Integrity" Subtree (STT01).
Is there any evidence of an integrity loss on the motor sensor connector on the motor ?
Complete
No
Yes
D
Defective motor. Replace motor.
Refer to the DanaTM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.


A
Using a multimeter in resistance mode, measure the resistance values of the motor connector pins for the excitation signals ®(R1_OUT to R2_OUT).
Motor sensor connector type 1
R1_OUT Connector pin
To
R2_OUT Connector pin
Pin P
Pin N
Motor sensor connector type 2
R1_OUT Connector pin
To
R2_OUT Connector pin
Pin A1
Pin B1
Is the measurement complying with the « Motor internal resistance measurements » table ?
Yes
No
D
Using a multimeter in resistance mode, measure the resistance values of the motor connector pins for the COS signals (COS+(S1) to COS-(S3)) .
Motor sensor connector type 1
COS+ (S1) Connector pin
To
COS- (S3) Connector pin
Pin L
Pin M
Motor sensor connector type 2
COS+ (S1) Connector pin
To
COS- (S3) Connector pin
Pin C1
Pin D1
No
Is the measurement complying with the « Motor internal resistance measurements » table ?
Yes
Using a multimeter in resistance mode, measure the resistance values of the motor connector pins for the SIN signals (SIN+(S2) TO SIN-(S4)).
Motor sensor connector type 1
SIN+ (S2) Connector pin
To
SIN- (S4) Connector pin
Pin J
Pin T
Motor sensor connector type 2
SIN+ (S2) Connector pin
To
SIN- (S4) Connector pin
Pin E1
Pin F1
Is the measurement complying with the « Motor internal resistance measurements » table ?
Yes
No
D
Using a multimeter in resistance mode, measure the resistance values of the motor connector pins for the HVIL signals.
Motor sensor connector type 1
HVIL_TO_MOTOR Connector pin
To
HVIL_TO_MOTOR Connector pin
Pin H
Pin K
Motor sensor connector type 2
HVIL_TO_MOTOR Connector pin
To
HVIL_TO_MOTOR Connector pin
Pin F4
Pin E4
C


C
Do the measurements comply with the « Motor internal resistance measurements » table ?
No
D
Yes
Using a multimeter in resistance mode, measure the resistance values of the motor connector pins for the Temperature C signals.
Motor sensor connector type 1
Motor sensor connector type 2
Temperature C+ Connector pin
Temperature C- Connector pin
Temperature C+ Connector pin
Temperature C- Connector pin
Pin A
To
Pin B
Pin F3
To
Pin F2
Is the measurement complying with the « Motor internal resistance measurements » table ?
No
D
Yes
Using a multimeter in resistance mode, measure the resistance values of the motor connector pins for the Temperature B signals.
Motor sensor connector type 1
Motor sensor connector type 2
Temperature B+ Connector pin
Temperature B- Connector pin
Temperature B+ Connector pin
Temperature B- Connector pin
Pin C
To
Pin D
Pin A3
To
Pin A2
Is the measurement complying with the « Motor internal resistance measurements » table ?
No
D
Yes
Using a multimeter in resistance mode, measure the resistance values of the motor connector pins for the Temperature D signals.
Motor sensor connector type 1
Motor sensor connector type 2
Temperature A+ Connector pin
Temperature A- Connector pin
Temperature A+ Connector pin
Temperature A- Connector pin
Pin E
To
Pin F
Pin A4
To
Pin B4
Is the measurement complying with the « Motor internal resistance measurements » table ?
No
D
Yes
B

TT06: Abnormal Battery Current Condition

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x0319	DC battery current exceeded allowed parameters	**1.** 0x3113 error occurred at the same time that may lead to a defective MCU **2.** 0x050B error occurred at the same time that may lead to an error at the VCU/ECU level. **3.** Another SysFile occurred at the same time. **4.** Defective MCU.

Description

The troubleshooting tree 06 describes an error where the DC battery current exceeded the allowed parameters.

This error is likely the result of the MCU being set to Standby or failure while the vehicle was at a high speed.

The check of the Specific SysFile ID occurring at the same time of another specific SysFile ID leads to determine if the MCU is defective.

The MCU itself may be defective.

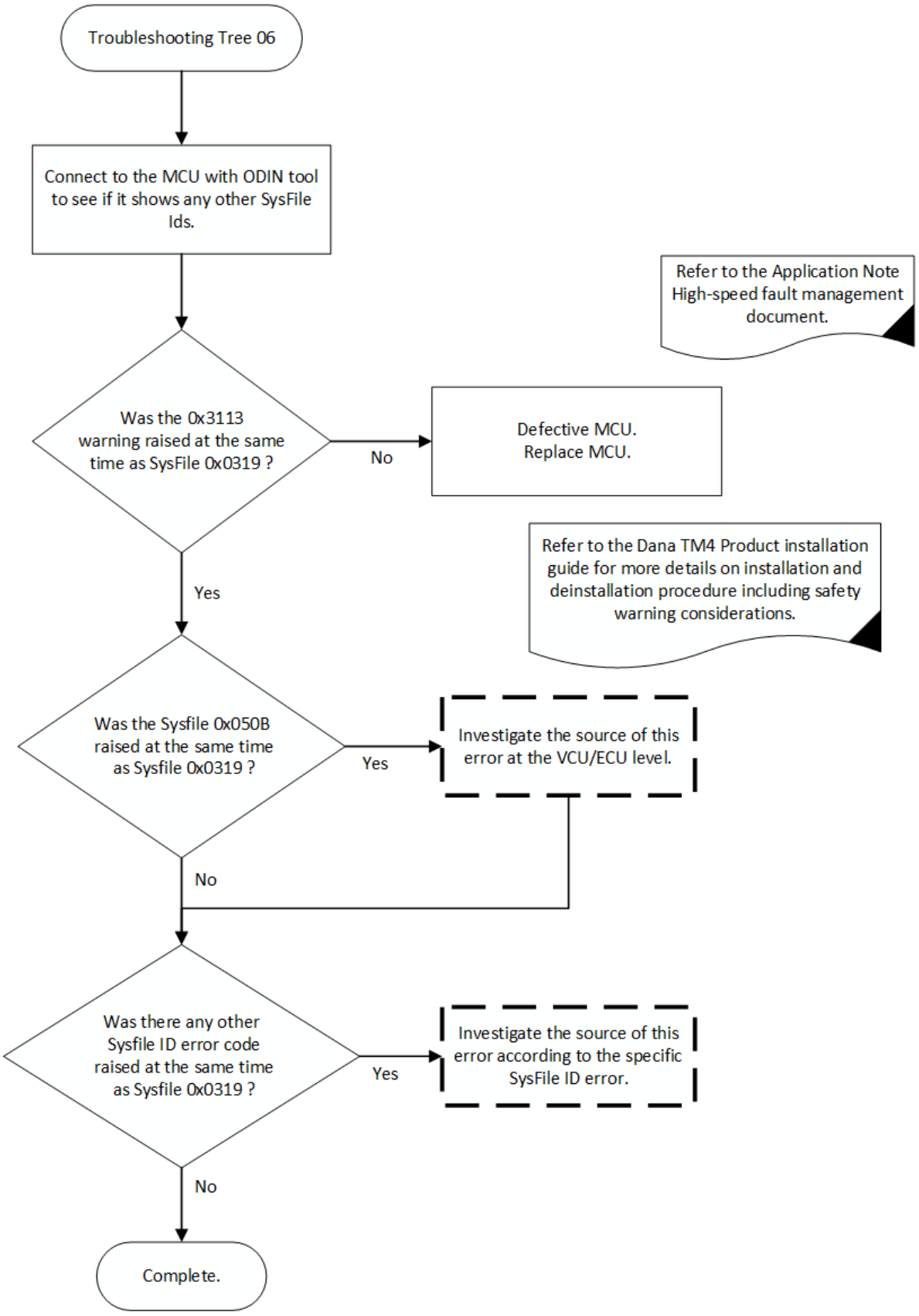
Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: Refer to the Application Note High-speed fault management document.

Note: Any SysFile ID raised by the system while the vehicle is beyond the "unsafe speed" will activate the phase short circuit mechanism through the MCU power switch modules. This mechanism is activated to maintain the DC bus under the high voltage maximum limit. At the time the motor phases are short circuited through the MCU power modules, the battery current will temporarily exceed the threshold limit upon failure and raise this SysFile ID error. This error can therefore be ignored following the 0x3113 warning (TT26) "Back EMF Motor reduction mechanism activated (phases are short-circuited)". Other error(s) must be investigated.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 06
Connect to the MCU with ODIN tool to see if it shows any other SysFile Ids.
Refer to the Application Note High-speed fault management document.
Was the 0x3113 warning raised at the same time as SysFile 0x0319 ?
No
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Yes
Was the Sysfile 0x050B raised at the same time as Sysfile 0x0319 ?
Yes
Investigate the source of this error at the VCU/ECU level.
No
Was there any other Sysfile ID error code raised at the same time as Sysfile 0x0319 ?
Yes
Investigate the source of this error according to the specific SysFile ID error.
No
Complete.

TT07: Phase Current Sensor Deactivated

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x031A 0x031B 0x031C	Phase current sensor deactivated.	**1.** If the 0x0313 SysFile occurred the same time this can be the main cause. **2.** Defective DCDC system. **3.** Defective auxiliary batteries. **4.** Defective MCU.

Description

Troubleshooting Tree 07 indicates that one phase currents sensor(s) over three related phases are deactivated, or are faulty.

The occurrence of the SysFile ID 0x0313 at the same time of these SysFile IDs means it has to refer to the Troubleshooting Tree TT03.

The low voltage due to DCDC or the auxiliary batteries may raise to this SysFile ID.

The MCU itself may be defective.

Note: These warning indicates a fault with a particular internal phase current sensor. An internal software mechanism is put in place to ignore the reading of a particular defective phase current sensor by simulating its value according to the 2 other working phase current sensors of the same 3 phase systems keeping the system in operation.
If ever a fault occurs on another internal phase current sensor, the system will go into fault reporting other error types.

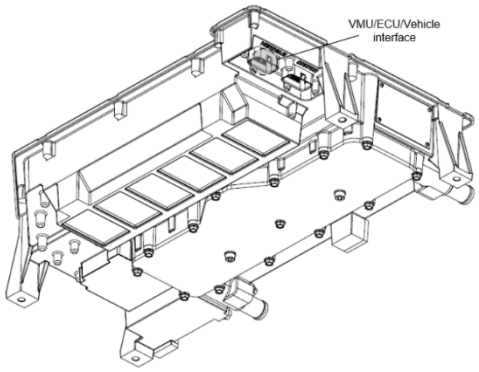
Note: Refer to the TT03 (SysFile ID 0x0313) entry for the “Vaux too low” Event for Vaux Verification and corrective actions (refer to steps in that TT03 tree that comes after voltage measurement).

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

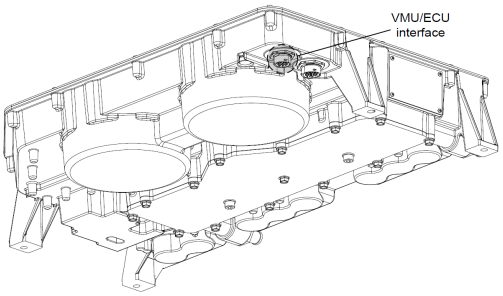
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Connector Head Identification

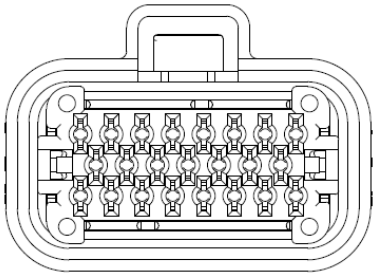
VMU/ECU Interface (Type 2)



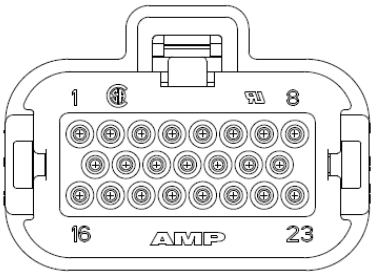
VMU/ECU Interface (Type 1)



VMU/ECU interface harness Plug Pinout (Type 2)

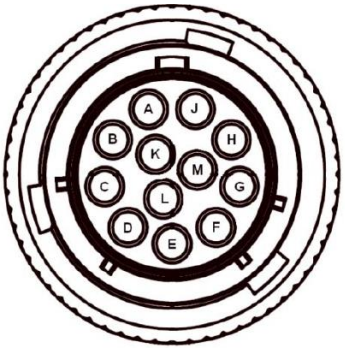


Connector (Front) (Type 2)

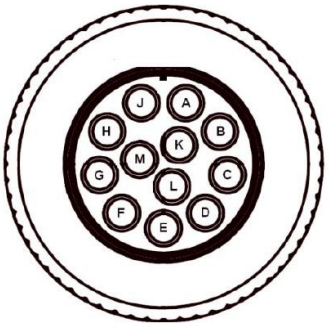


Wire Insertion Side (Back) (Type 2)

VMU/ECU interface harness Plug Pinout (Type1)



Connector (Front) (Type 1)



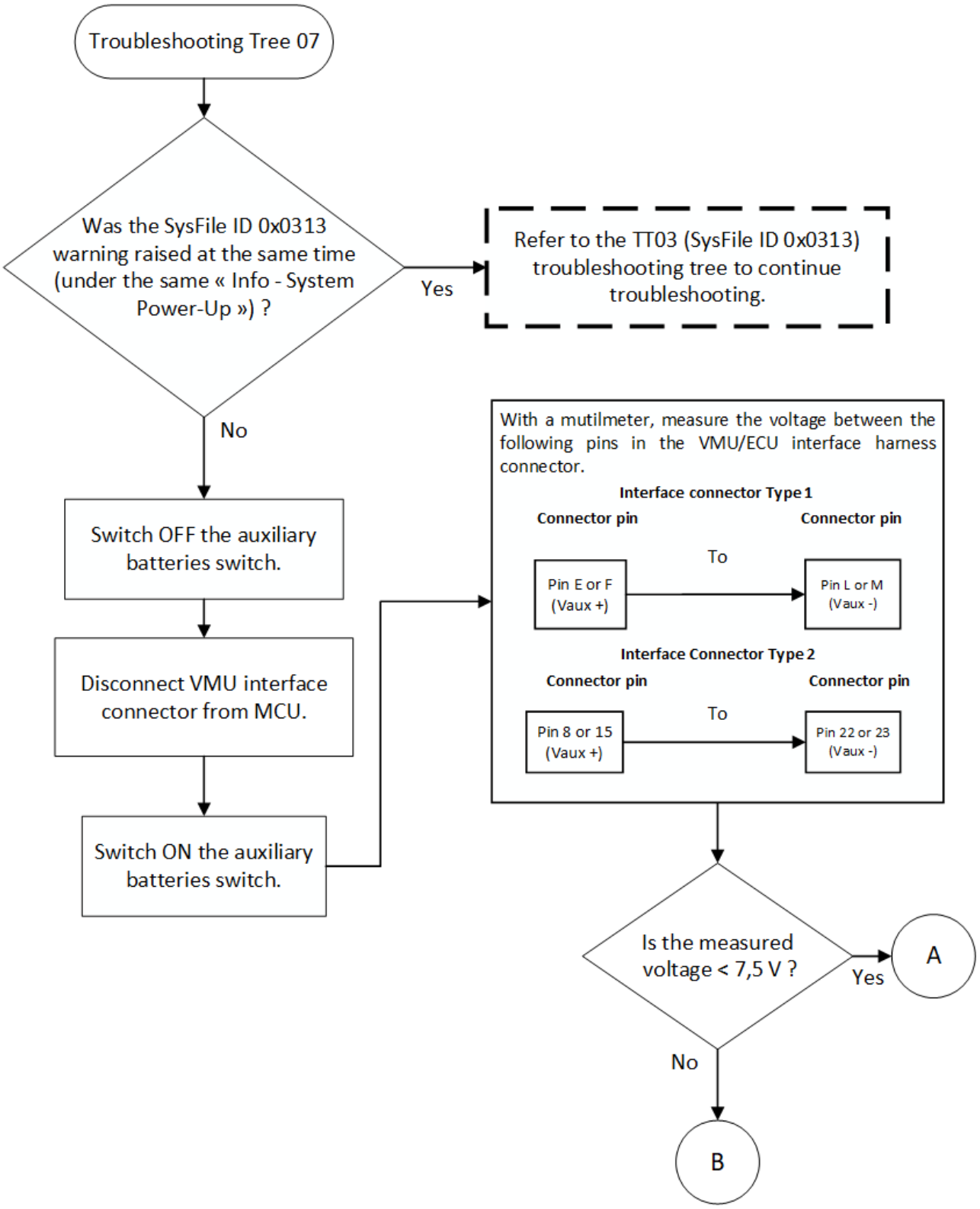
Wire Insertion Side (Back) (Type 1)

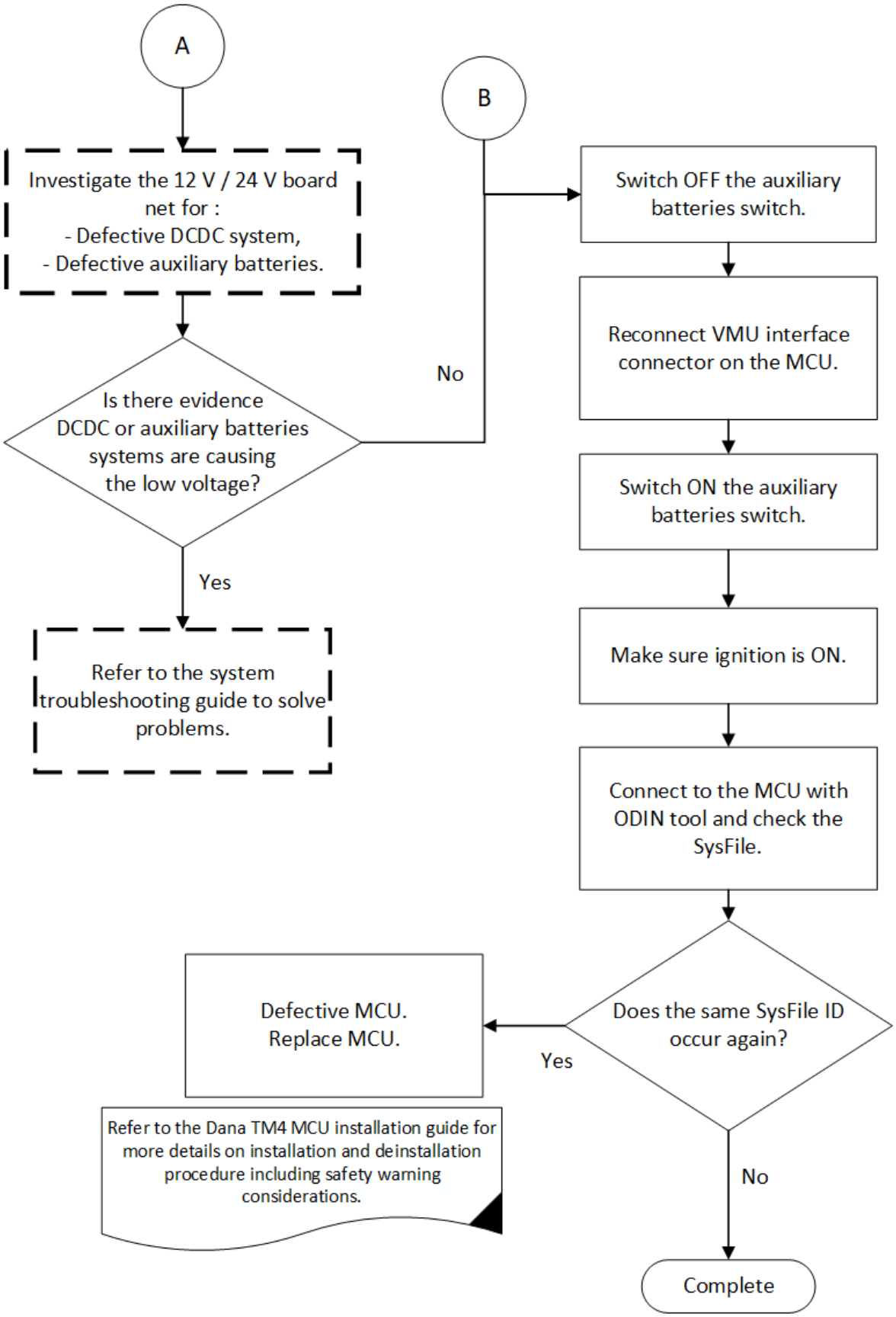
Connector type 2 pinout

Pin	Signal names
15	V^{AUX} +
8	
22	V^{AUX} -
23	
1	IGNITION
9	CAN1L
16	CAN1H
2	CAN2L
10	CAN2H
18	HVIL_IN
19	HVIL_OUT
5	ANALOG1
13	ANALOG3
20	ANALOG2
6	DIGITAL INPUT 1
14	DIGITAL INPUT 3
21	DIGITAL INPUT 2
7	HS_OUT
17	GND_SENSORS
3	CAN SHIELD
11	5V_SENSOR
4	PWM1_OUT
12	PWM2_OUT

Connector type 1 pinout

Pin	Signal names
E	V^{AUX} +
F	
L	V^{AUX} -(Chassis)
M	
G	IGNITION
A	CAN1L
B	CAN1H
C	CAN2L
D	CAN2H
J	HVIL
K	HVIL
H	Emergency stop


Troubleshooting Tree 07
Was the SysFile ID 0x0313 warning raised at the same time (under the same « Info - System Power-Up ») ?
Yes
Refer to the TT03 (SysFile ID 0x0313) troubleshooting tree to continue troubleshooting.
No
Switch OFF the auxiliary batteries switch.
Disconnect VMU interface connector from MCU.
Switch ON the auxiliary batteries switch.
With a mutilmeter, measure the voltage between the following pins in the VMU/ECU interface harness connector.
Interface connector Type 1
Connector pin
Connector pin
To
Pin E or F (Vaux +)
Pin L or M (Vaux -)
Interface Connector Type 2
Connector pin
Connector pin
To
Pin 8 or 15 (Vaux +)
Pin 22 or 23 (Vaux -)
Is the measured voltage < 7,5 V ?
Yes
A
No
B


A
B
Investigate the 12 V / 24 V board net for :
- Defective DCDC system,
- Defective auxiliary batteries.
Is there evidence DCDC or auxiliary batteries systems are causing the low voltage?
No
Yes
Refer to the system troubleshooting guide to solve problems.
Switch OFF the auxiliary batteries switch.
Reconnect VMU interface connector on the MCU.
Switch ON the auxiliary batteries switch.
Make sure ignition is ON.
Connect to the MCU with ODIN tool and check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.
No
Complete

TT08: HVIL voltage input fault

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x031D	The HVIL circuit had a current or voltage that was outside the limits.	**1.** MCU HVIL parameters were not correctly configured. **2.** Another system opens the HVIL loop from the HVIL input of the MCU. **3.** Defective VMU/MCU interface connector on the MCU. **4.** Defective MCU.

HVIL

The HVIL is short for “High Voltage Interlock Loop”. HVIL is a hardware signal, and its purpose is to protect the user. When the system is fully installed and connected, the HVIL internal loop is closed which results in a short circuit between its two input pins. The HVIL signal is used to open the high-voltage battery contactor when its internal loop is opened during product maintenance or repair (e.g. removal of MCU cover or disconnection of motor sensor cable) thereby protecting the user.

Description

The Troubleshooting Tree 08 indicates an error where the detected voltage for the HVIL loop is outside of the limits set by the Operations and Maintenance guide.

The potential causes of this SysFile ID are listed below, in order of likelihood:

1. The HVIL parameters of the MCU are not set correctly according the user preferences, and the Operation and Maintenance guide. The HVIL parameters should be updated in the MCU.
2. There is another system that is opening the HVIL loop from the HVIL input of the MCU. To fix this fault refer to the troubleshooting guide of the other system.
3. The connectors that connect the HVIL circuit to the MCU are somehow defective. In this case, the VMU/ECU connectors must be disconnected from the MCU and repaired.
4. The MCU itself is defective. It should be disconnected and replaced.

Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

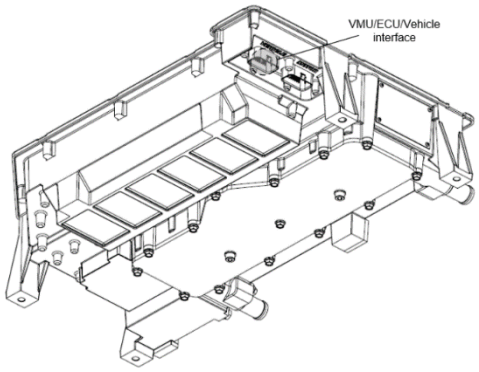
Note: Refer to the TM4 Product Operation and maintenance guide for more details.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

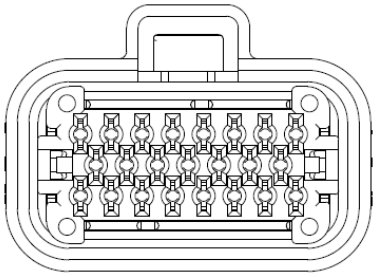
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Connector Head Identification

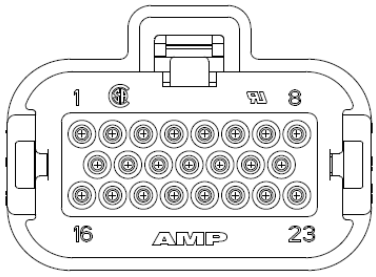
VMU/ECU Interface (Type 2)



VMU/ECU interface harness Plug Pinout (Type 2)



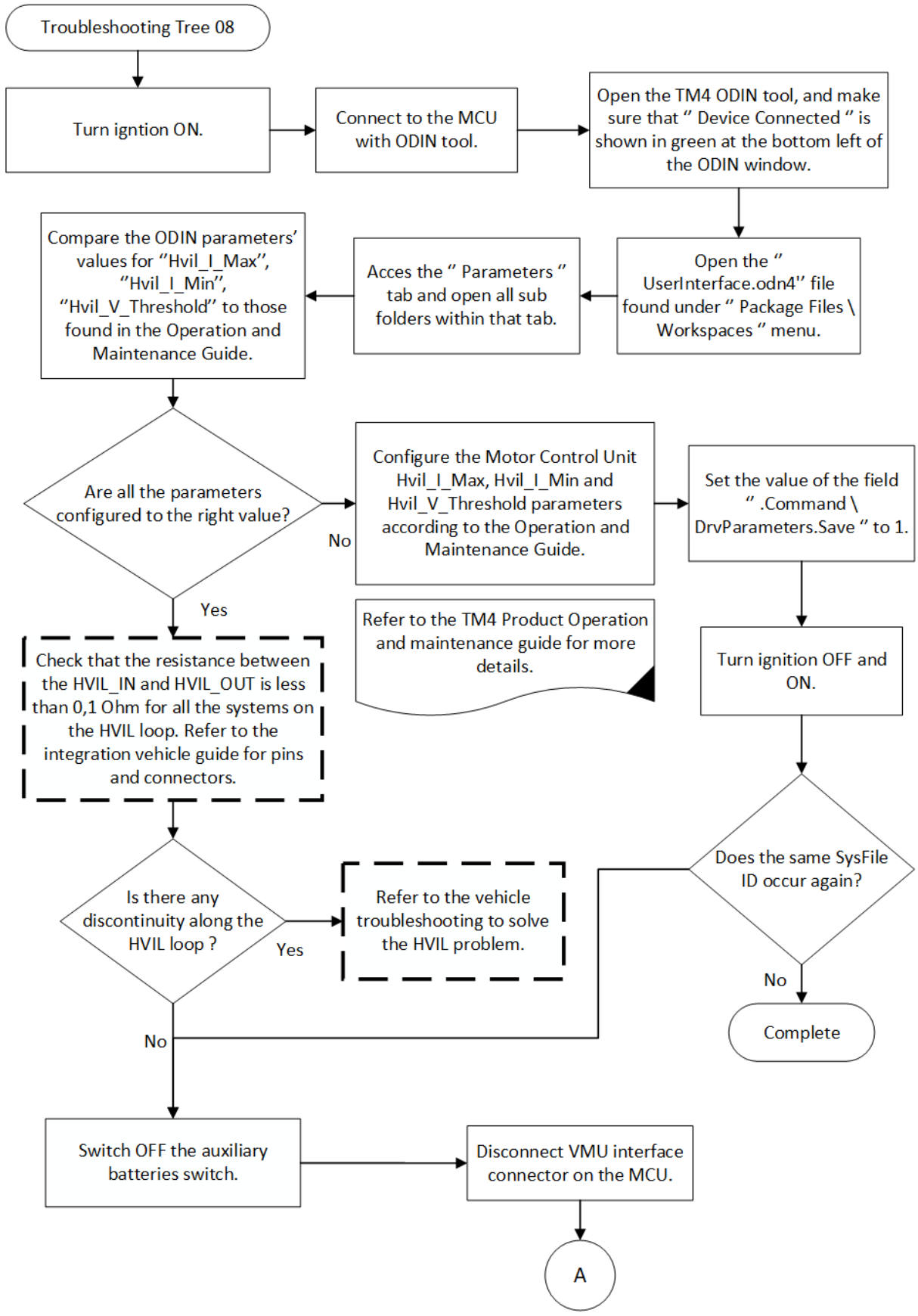
Connector (Front) (Type 2)

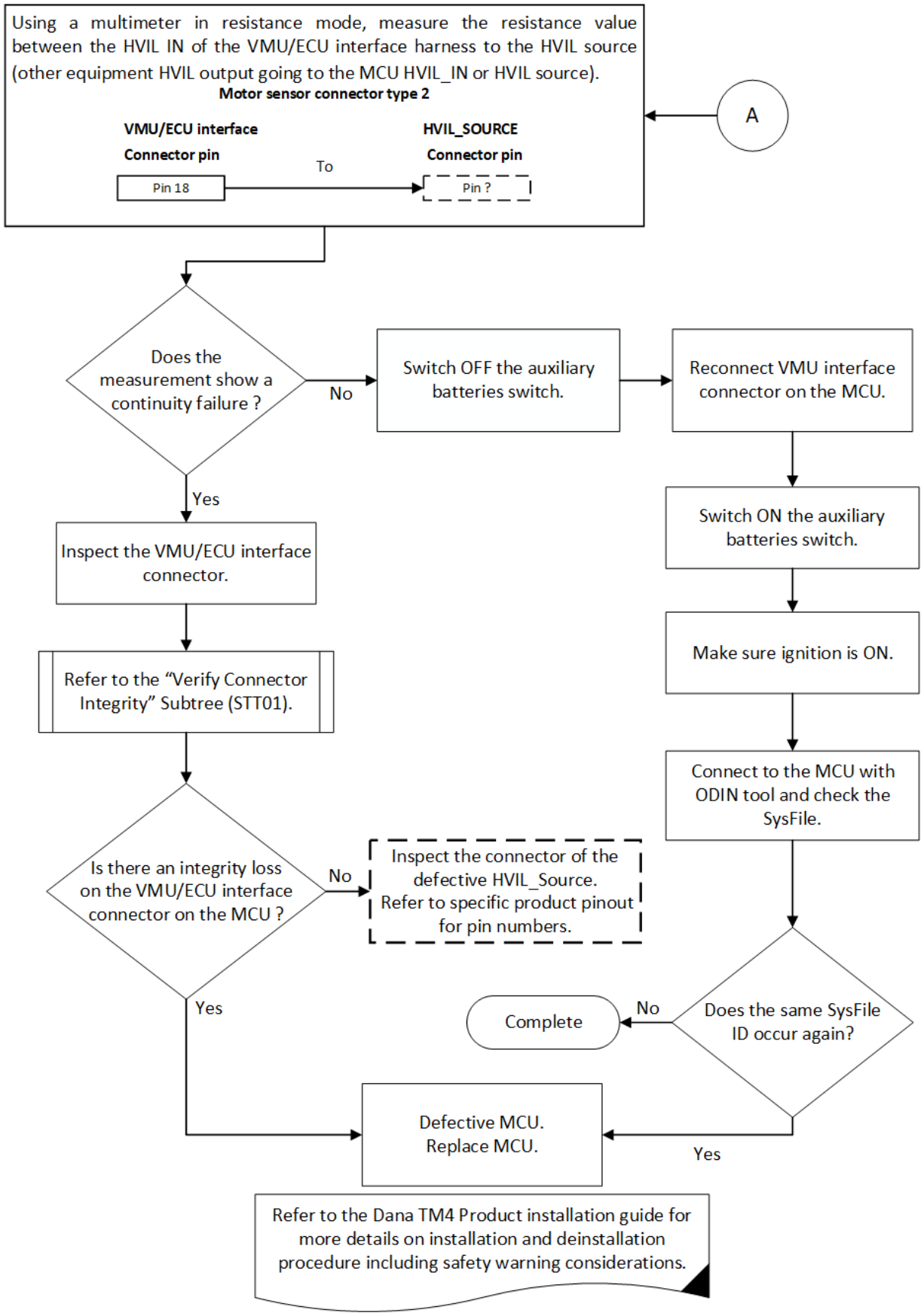


Wire Insertion Side (Back) (Type 2)

Connector type 2 pinout

Pin	Signal names
15	V^{AUX} +
8	
22	V^{AUX} -
23	
1	IGNITION
9	CAN1L
16	CAN1H
2	CAN2L
10	CAN2H
18	HVIL_IN
19	HVIL_OUT
5	ANALOG1
13	ANALOG3
20	ANALOG2
6	DIGITAL INPUT 1
14	DIGITAL INPUT 3
21	DIGITAL INPUT 2
7	HS_OUT
17	GND_SENSORS
3	CAN SHIELD
11	5V_SENSOR
4	PWM1_OUT
12	PWM2_OUT


Troubleshooting Tree 08
Turn igntion ON.
Connect to the MCU with ODIN tool.
Open the TM4 ODIN tool, and make sure that " Device Connected " is shown in green at the bottom left of the ODIN window.
Open the " UserInterface.odn4" file found under " Package Files \ Workspaces " menu.
Acces the " Parameters " tab and open all sub folders within that tab.
Compare the ODIN parameters' values for "Hvil_I_Max", "Hvil_I_Min", "Hvil_V_Threshold" to those found in the Operation and Maintenance Guide.
Are all the parameters configured to the right value?
No
Configure the Motor Control Unit Hvil_I_Max, Hvil_I_Min and Hvil_V_Threshold parameters according to the Operation and Maintenance Guide.
Set the value of the field " .Command \ DrvParameters.Save " to 1.
Refer to the TM4 Product Operation and maintenance guide for more details.
Yes
Check that the resistance between the HVIL_IN and HVIL_OUT is less than 0,1 Ohm for all the systems on the HVIL loop. Refer to the integration vehicle guide for pins and connectors.
Turn ignition OFF and ON.
Does the same SysFile ID occur again?
Is there any discontinuity along the HVIL loop ?
Yes
Refer to the vehicle troubleshooting to solve the HVIL problem.
No
Complete
No
Switch OFF the auxiliary batteries switch.
Disconnect VMU interface connector on the MCU.
A


Using a multimeter in resistance mode, measure the resistance value between the HVIL IN of the VMU/ECU interface harness to the HVIL source (other equipment HVIL output going to the MCU HVIL_IN or HVIL source).
Motor sensor connector type 2
VMU/ECU interface Connector pin
Pin 18
To
HVIL_SOURCE Connector pin
Pin ?
A
Does the measurement show a continuity failure ?
No
Switch OFF the auxiliary batteries switch.
Reconnect VMU interface connector on the MCU.
Switch ON the auxiliary batteries switch.
Make sure ignition is ON.
Connect to the MCU with ODIN tool and check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Yes
Inspect the VMU/ECU interface connector.
Refer to the "Verify Connector Integrity" Subtree (STT01).
Is there an integrity loss on the VMU/ECU interface connector on the MCU ?
No
Inspect the connector of the defective HVIL_Source. Refer to specific product pinout for pin numbers.
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT09: HVIL Output Fault

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x031E	The output of the HVIL line had a fault.	**1.** MCU HVIL parameters were not correctly configured. **2.** Another system opens the HVIL loop from the HVIL input of the MCU. **3.** Defective VMU/MCU interface connector on the MCU. **4.** Defective MCU.

HVIL

The HVIL is short for “High Voltage Interlock Loop”. HVIL is a hardware signal, and its purpose is to protect the user. When the system is fully installed and connected, the HVIL internal loop is closed which results in a short circuit between its two input pins. The HVIL signal is used to open the high-voltage battery contactor when its internal loop is opened during product maintenance or repair (e.g. removal of the MCU cover or disconnection of motor sensor cable) thereby protecting the user.

Description

The troubleshooting tree 09 indicates an error where the detected high voltage for the HVIL loop is outside of the limits set by the Operations and Maintenance guide.

The potential causes of this SysFile ID are listed below, in order of likelihood:

1. The HVIL parameters of the MCU are not set correctly according the user preferences, and the Operation and Maintenance guide.
2. There is another system that is opening the HVIL loop from the HVIL output of the MCU. To fix this fault refer to the troubleshooting guide of the other system.
3. The connectors that connect the HVIL circuit to the MCU are somehow defective. In this case, the system must be turned OFF and the connectors must be repaired.
4. The MCU itself is defective, and must be replaced.

Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

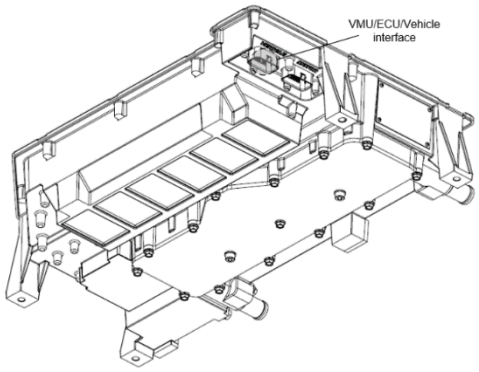
Note: Refer to the TM4 Product Operation and maintenance guide for more details.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

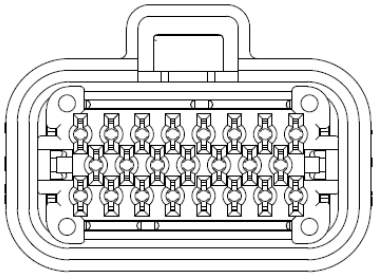
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Connector Head Identification

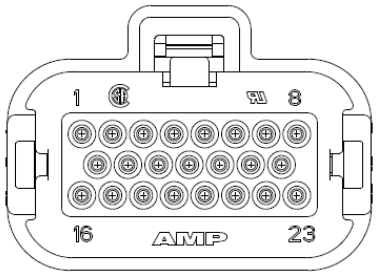
VMU/ECU Interface (Type 2)



VMU/ECU interface harness Plug Pinout (Type 2)



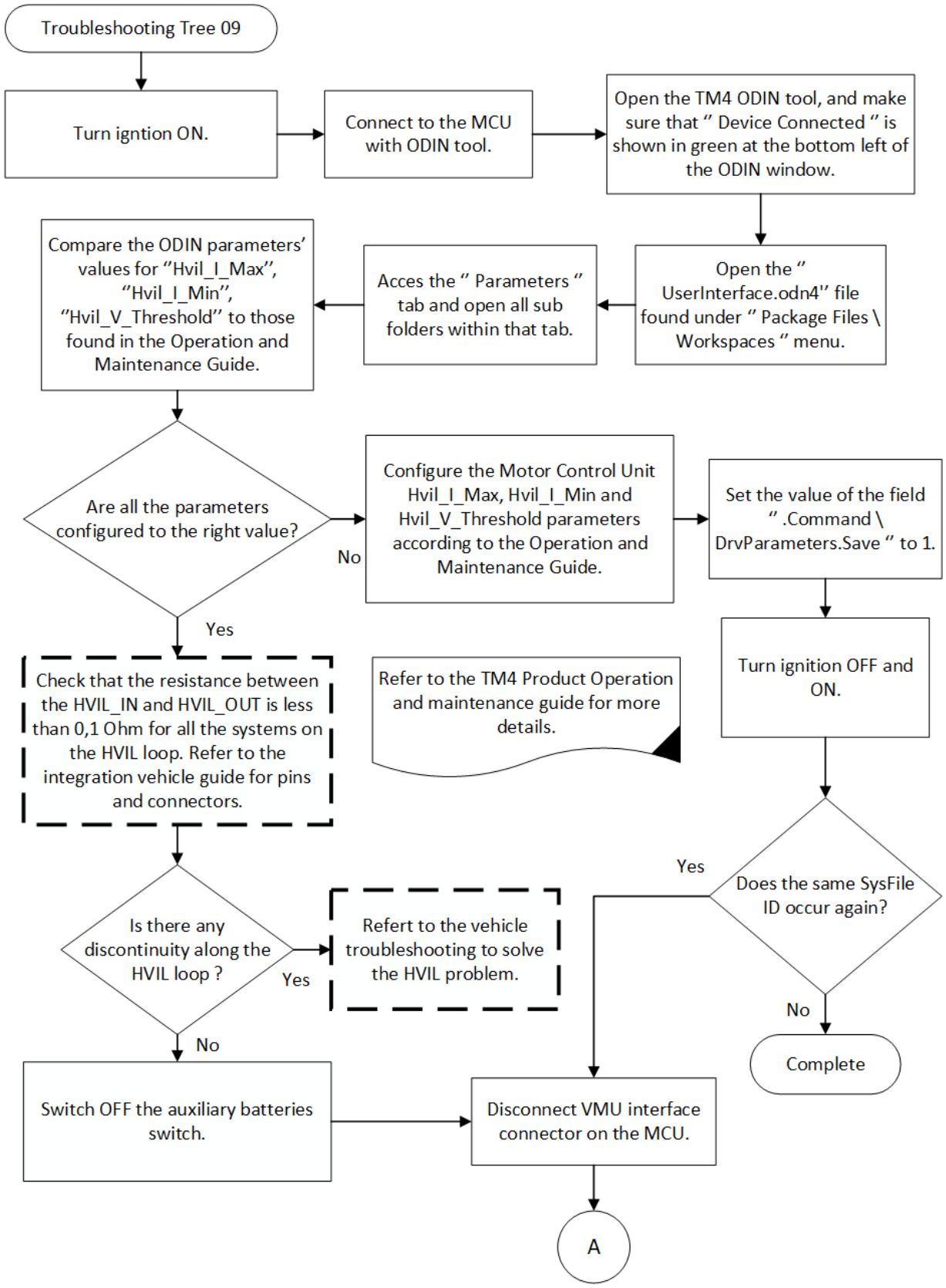
Connector (Front) (Type 2)

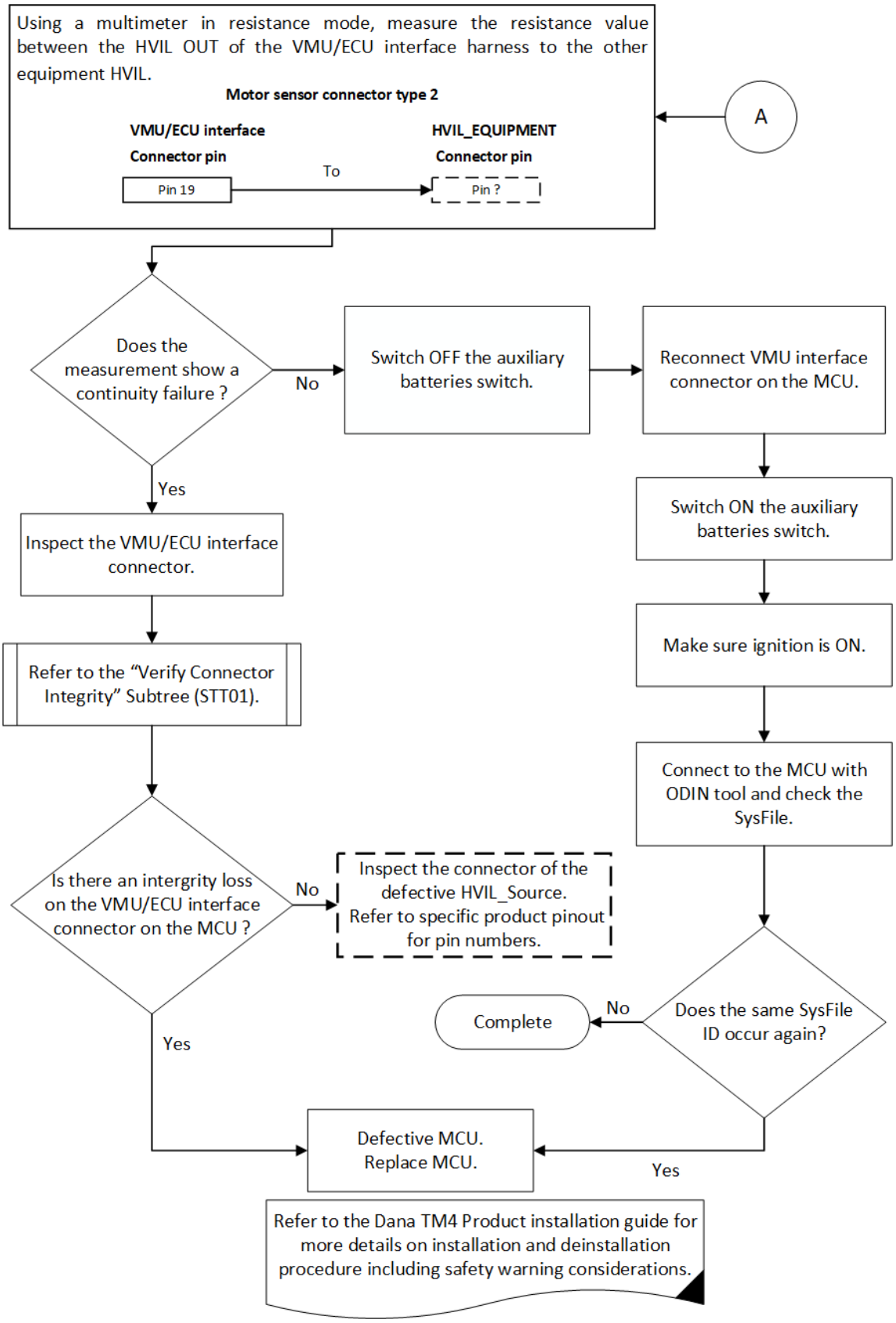


Wire Insertion Side (Back) (Type 2)

Connector type 2 pinout

Pin	Signal names
15	V^{AUX} +
8	
22	V^{AUX} -
23	
1	IGNITION
9	CAN1L
16	CAN1H
2	CAN2L
10	CAN2H
18	HVIL_IN
19	HVIL_OUT
5	ANALOG1
13	ANALOG3
20	ANALOG2
6	DIGITAL INPUT 1
14	DIGITAL INPUT 3
21	DIGITAL INPUT 2
7	HS_OUT
17	GND_SENSORS
3	CAN SHIELD
11	5V_SENSOR
4	PWM1_OUT
12	PWM2_OUT


Troubleshooting Tree 09
Turn igntion ON.
Connect to the MCU with ODIN tool.
Open the TM4 ODIN tool, and make sure that " Device Connected " is shown in green at the bottom left of the ODIN window.
Open the " UserInterface.odn4" file found under " Package Files \ Workspaces " menu.
Acces the " Parameters " tab and open all sub folders within that tab.
Compare the ODIN parameters' values for "Hvil_I_Max", "Hvil_I_Min", "Hvil_V_Threshold" to those found in the Operation and Maintenance Guide.
Are all the parameters configured to the right value?
No
Configure the Motor Control Unit Hvil_I_Max, Hvil_I_Min and Hvil_V_Threshold parameters according to the Operation and Maintenance Guide.
Set the value of the field " .Command \ DrvParameters.Save " to 1.
Turn ignition OFF and ON.
Yes
Check that the resistance between the HVIL_IN and HVIL_OUT is less than 0,1 Ohm for all the systems on the HVIL loop. Refer to the integration vehicle guide for pins and connectors.
Refer to the TM4 Product Operation and maintenance guide for more details.
Does the same SysFile ID occur again?
Yes
No
Complete
Is there any discontinuity along the HVIL loop ?
Yes
Refert to the vehicle troubleshooting to solve the HVIL problem.
No
Switch OFF the auxiliary batteries switch.
Disconnect VMU interface connector on the MCU.
A


Using a multimeter in resistance mode, measure the resistance value between the HVIL OUT of the VMU/ECU interface harness to the other equipment HVIL.
Motor sensor connector type 2
VMU/ECU interface
Connector pin
Pin 19
To
HVIL_EQUIPMENT
Connector pin
Pin ?
A
Does the measurement show a continuity failure ?
No
Switch OFF the auxiliary batteries switch.
Reconnect VMU interface connector on the MCU.
Switch ON the auxiliary batteries switch.
Make sure ignition is ON.
Connect to the MCU with ODIN tool and check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Defective MCU. Replace MCU.
Yes
Inspect the VMU/ECU interface connector.
Refer to the "Verify Connector Integrity" Subtree (STT01).
Is there an intergrity loss on the VMU/ECU interface connector on the MCU ?
No
Inspect the connector of the defective HVIL_Source. Refer to specific product pinout for pin numbers.
Yes
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT10: Internal HVIL connection fault

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x031F	The HVIL line experienced an internal connection fault.	**1.** MCU HVIL parameters were not properly configured. **2.** MCU phase cables not inserted properly with locking screws installed. **3.** Motor phase cables not inserted properly with locking screws installed. **4.** DC input cables not inserted properly with locking screws installed. **5.** Motor sensor cable not properly inserted properly. **6.** Defective motor sensor cable. **7.** Defective motor. **8.** Defective MCU.

HVIL

The HVIL is short for “High Voltage Interlock Loop”. HVIL is a hardware signal, and its purpose is to protect the user. When the system is fully installed and connected, the HVIL internal loop is closed which results in a short circuit between its two input pins. The HVIL signal is used to open the high-voltage battery contactor when its internal loop is opened during product maintenance or repair (e.g. removal of MCU cover or disconnection of motor sensor cable) thereby protecting the user.

Description

The Troubleshooting Tree 10 indicates that the HVIL lines have an internal fault. The possible causes of this error are listed below, in order of likelihood:

1. The HVIL parameters were not configured correctly. The user must access the parameters through TM4 ODIN and set them.
2. The MCU phase cables, sensor cables, or DC input cables are not inserted properly. The system must be turned OFF before the cables can be inserted and locked in again.
3. The motor sensor cable may not be fully inserted with connector locking mechanism engaged in both sides (MCU and motor). The system must be turned OFF and then the cables must be locked by the locking mechanism engaged on both sides (MCU and motor).
4. The motor is defective.
5. The MCU is defective.

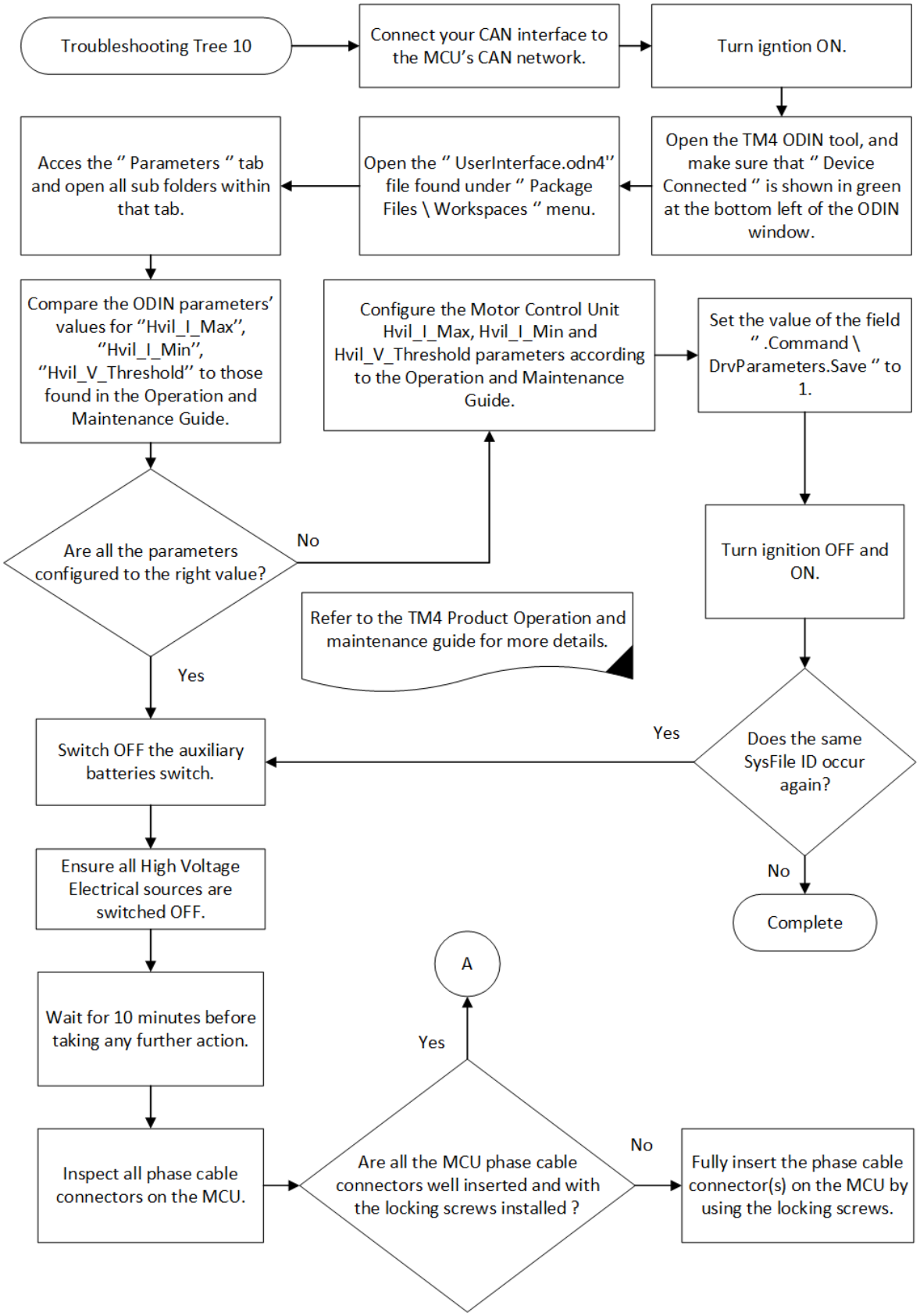
Note: Refer to the TM4 Product Operation and maintenance guide for more details.

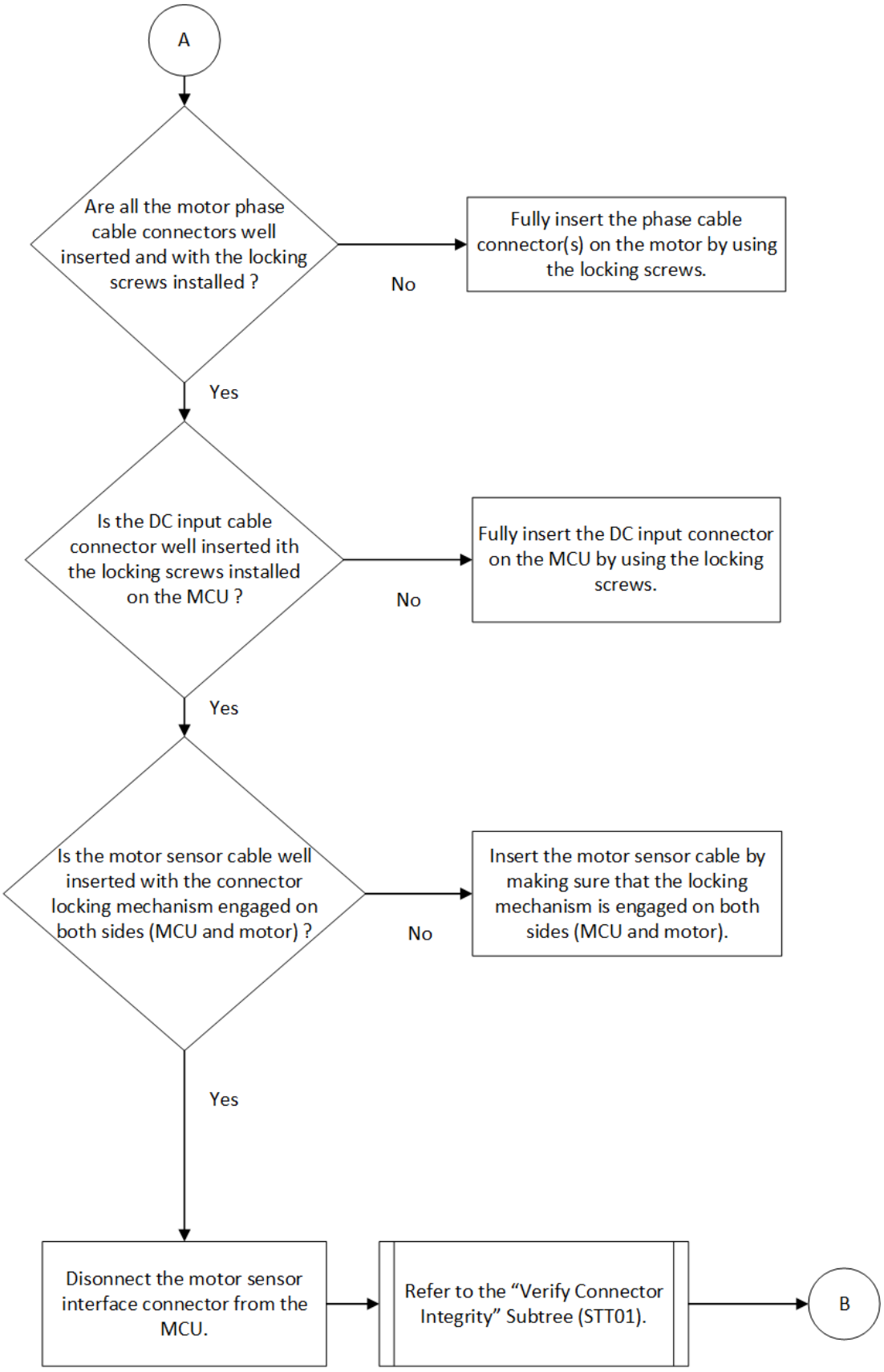
Note: Refer to the TM4 MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations

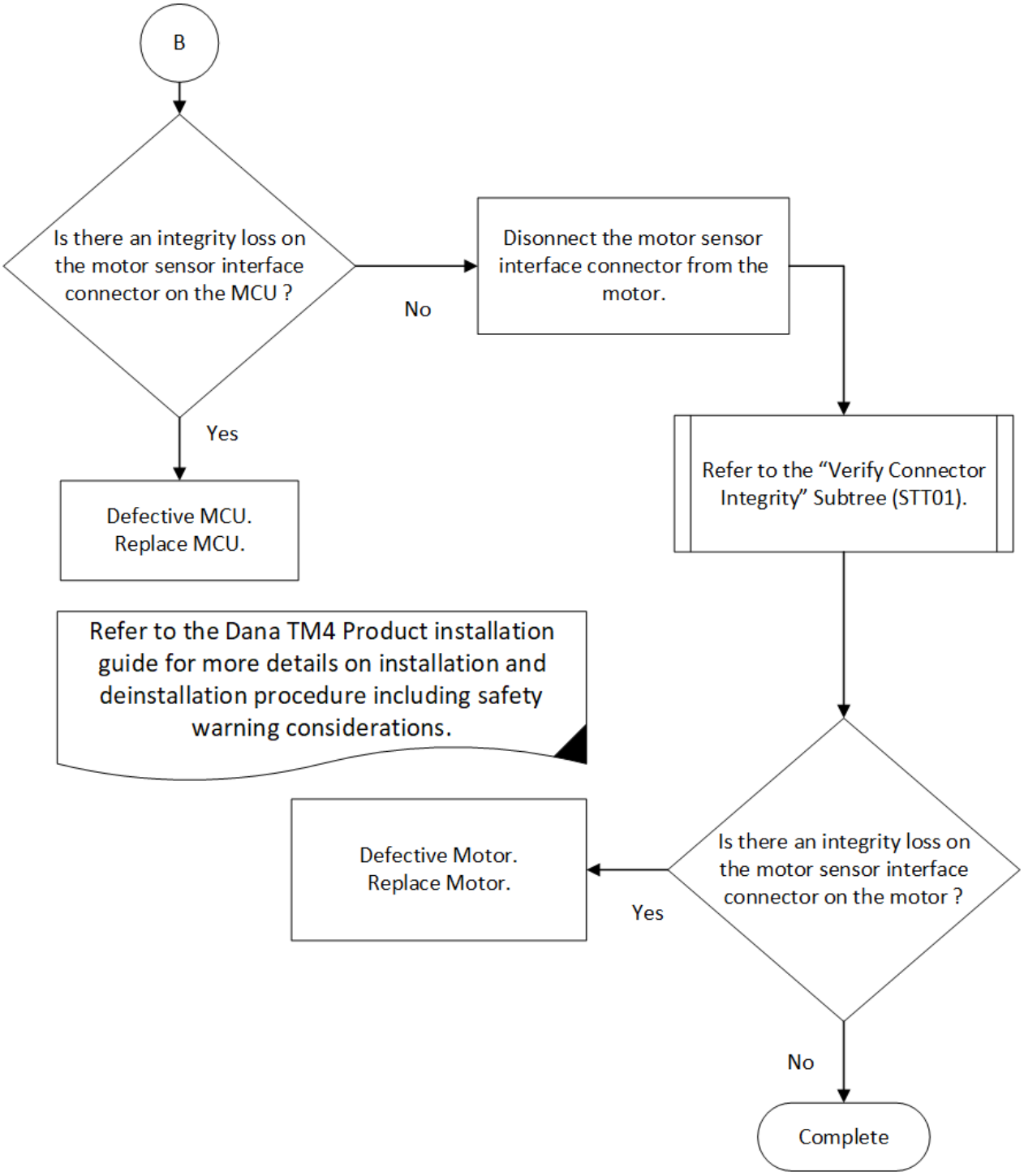
Note: Refer to the TM4 motor installation guide for more details on installation and deinstallation procedure including safety warning considerations

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 10
Connect your CAN interface to the MCU's CAN network.
Turn igntion ON.
Open the TM4 ODIN tool, and make sure that " Device Connected " is shown in green at the bottom left of the ODIN window.
Open the " UserInterface.odn4" file found under " Package Files \ Workspaces " menu.
Acces the " Parameters " tab and open all sub folders within that tab.
Compare the ODIN parameters' values for "Hvil_I_Max", "Hvil_I_Min", "Hvil_V_Threshold" to those found in the Operation and Maintenance Guide.
Configure the Motor Control Unit Hvil_I_Max, Hvil_I_Min and Hvil_V_Threshold parameters according to the Operation and Maintenance Guide.
Set the value of the field " .Command \ DrvParameters.Save " to 1.
Are all the parameters configured to the right value?
No
Yes
Refer to the TM4 Product Operation and maintenance guide for more details.
Turn ignition OFF and ON.
Does the same SysFile ID occur again?
Yes
No
Complete
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Inspect all phase cable connectors on the MCU.
Are all the MCU phase cable connectors well inserted and with the locking screws installed ?
Yes
A
No
Fully insert the phase cable connector(s) on the MCU by using the locking screws.


A
Are all the motor phase cable connectors well inserted and with the locking screws installed ?
No
Fully insert the phase cable connector(s) on the motor by using the locking screws.
Yes
Is the DC input cable connector well inserted ith the locking screws installed on the MCU ?
No
Fully insert the DC input connector on the MCU by using the locking screws.
Yes
Is the motor sensor cable well inserted with the connector locking mechanism engaged on both sides (MCU and motor) ?
No
Insert the motor sensor cable by making sure that the locking mechanism is engaged on both sides (MCU and motor).
Yes
Disonnect the motor sensor interface connector from the MCU.
Refer to the "Verify Connector Integrity" Subtree (STT01).
B


B
Is there an integrity loss on the motor sensor interface connector on the MCU ?
No
Disonnect the motor sensor interface connector from the motor.
Yes
Defective MCU. Replace MCU.
Refer to the "Verify Connector Integrity" Subtree (STT01).
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Defective Motor. Replace Motor.
Is there an integrity loss on the motor sensor interface connector on the motor ?
Yes
No
Complete

TT11: HVIL over current

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x0320	HVIL over current fault was detected.	**1.** MCU HVIL parameters were not properly configured. **2.** HVIL power source fault. **3.** Defective MCU.

HVIL

The HVIL is short for “High Voltage Interlock Loop”. HVIL is a hardware signal, and its purpose is to protect the user. When the system is fully installed and connected, the HVIL internal loop is closed which results in a short circuit between its two input pins. The HVIL signal is used to open the high-voltage battery contactor when its internal loop is opened during product maintenance or repair (e.g. removal of MCU cover or disconnection of motor sensor cable) thereby protecting the user.

Description

The troubleshooting tree 11 indicates an error where the HVIL current was greater than the maximum allowed current. The possible causes of this error are listed below, in order of likelihood:

1. The HVIL parameters were not configured correctly. To correct this, the user must access the TM4 ODIN tool and go to the HVIL parameters to set them according to the needs and the limits set by the Operations and Maintenance Guide.
2. There is a problem with the HVIL power source that is connected to the HVIL line. This problem is external to the Motor Control Unit (MCU), refer to HVIL source Troubleshooting Guide.
3. The MCU is defective. The system must be turned OFF, and the MCU removed and replaced.

Note: Refer to the TM4 Product Operation and maintenance guide for more details.

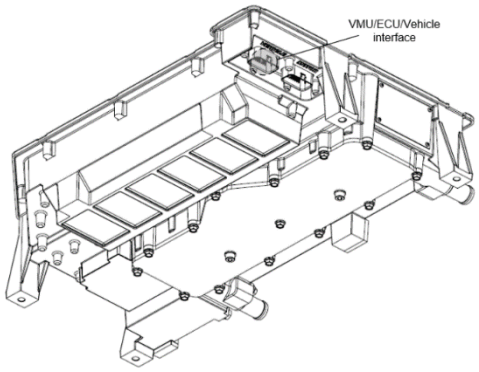
Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

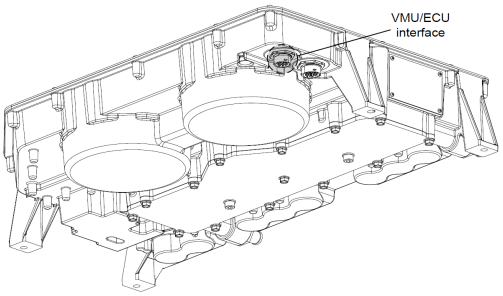
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Connector Head Identification

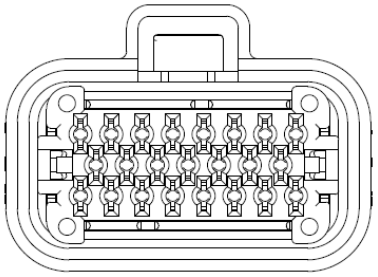
VMU/ECU Interface (Type 2)



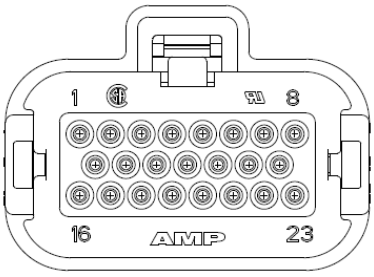
VMU/ECU Interface (Type 1)



VMU/ECU interface harness Plug Pinout (Type 2)

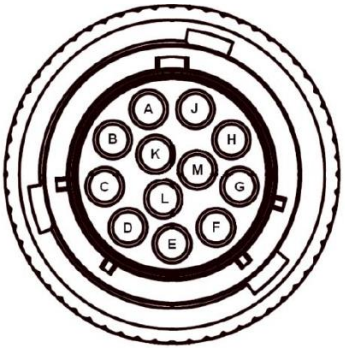


Connector (Front) (Type 2)

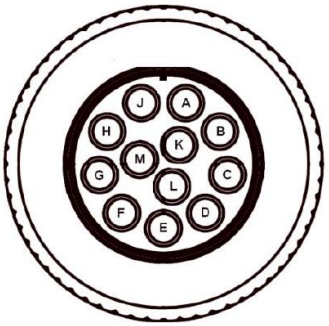


Wire Insertion Side (Back) (Type 2)

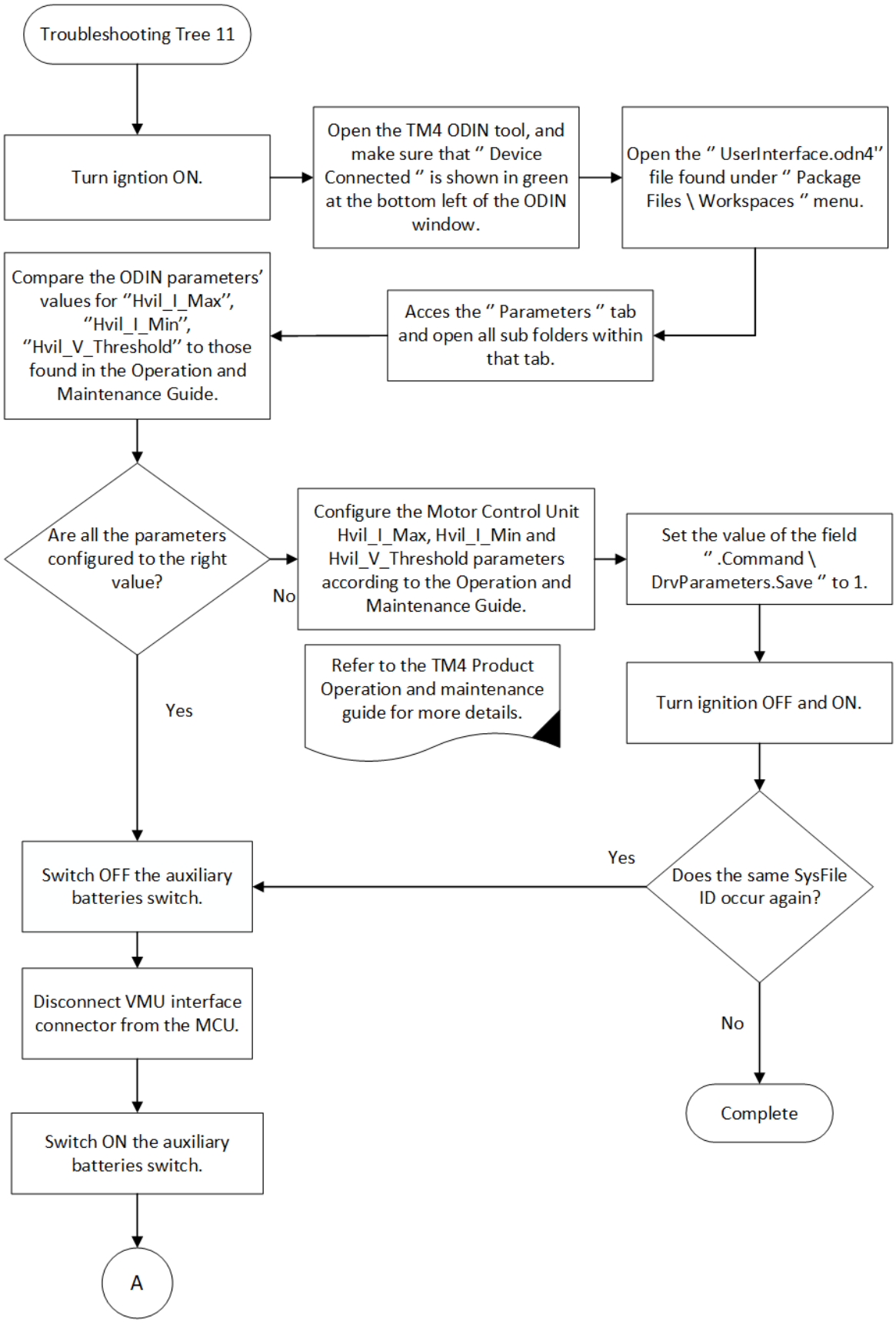
VMU/ECU interface harness Plug Pinout (Type1)

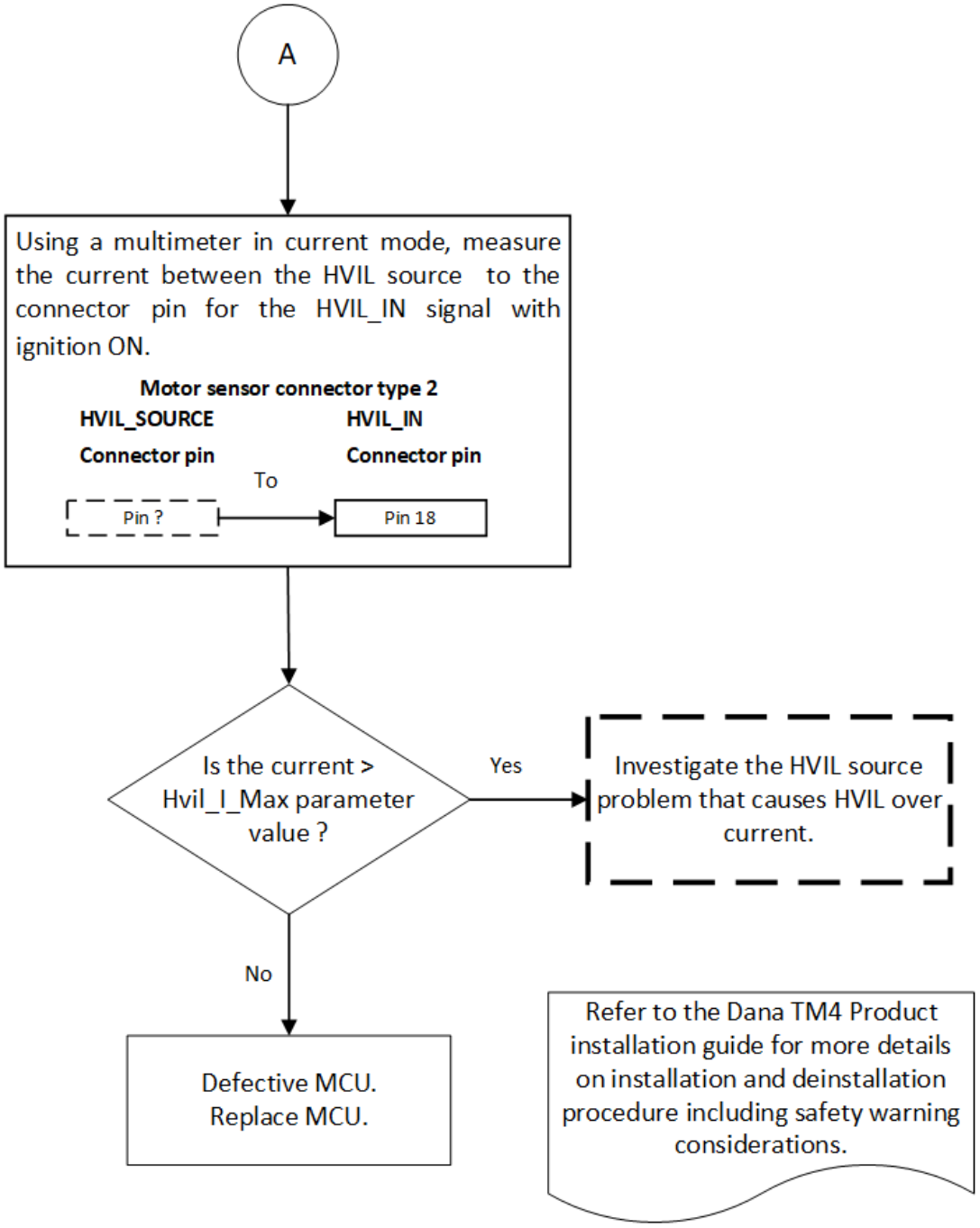


Connector (Front) (Type 1)



Wire Insertion Side (Back) (Type 1)


Troubleshooting Tree 11
Turn igntion ON.
Open the TM4 ODIN tool, and make sure that " Device Connected " is shown in green at the bottom left of the ODIN window.
Open the " UserInterface.odn4" file found under " Package Files \ Workspaces " menu.
Acces the " Parameters " tab and open all sub folders within that tab.
Compare the ODIN parameters' values for "Hvil_I_Max", "Hvil_I_Min", "Hvil_V_Threshold" to those found in the Operation and Maintenance Guide.
Are all the parameters configured to the right value?
No
Configure the Motor Control Unit Hvil_I_Max, Hvil_I_Min and Hvil_V_Threshold parameters according to the Operation and Maintenance Guide.
Set the value of the field " .Command \ DrvParameters.Save " to 1.
Refer to the TM4 Product Operation and maintenance guide for more details.
Turn ignition OFF and ON.
Yes
Does the same SysFile ID occur again?
Yes
Switch OFF the auxiliary batteries switch.
No
Complete
Disconnect VMU interface connector from the MCU.
Switch ON the auxiliary batteries switch.
A


A
Using a multimeter in current mode, measure the current between the HVIL source to the connector pin for the HVIL_IN signal with ignition ON.
Motor sensor connector type 2
HVIL_SOURCE
Connector pin
HVIL_IN
Connector pin
To
Pin ?
Pin 18
Is the current > Hvil_I_Max parameter value ?
Yes
Investigate the HVIL source problem that causes HVIL over current.
No
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT12: Initialization Timed Out

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x0504	Initialization of Motor Control timed out, and couldn't be completed.	**1.** Wrong motor type connected to the MCU. **2.** Wrong software flashed to the MCU. **3.** Defective MCU (Potential wrong factory settings).

Description

The Troubleshooting Tree 12 indicates an error where the Initialization of the MCU timed out, and couldn't be completed.

Listed below are the possible causes of this SysFile ID, in order of likelihood:

1. The wrong type of MCU is connected to your system. Check the MCU part number written on the MCU. If this is not compatible with your system installed, make sure to use the correct system with the MCU part number.
2. Check the motor part number written on the motor. If this is not compatible with your system installed, make sure to use the correct system with the motor part number.
3. The wrong software version was flashed to the MCU. In this case, check the correct software version from Dana TM4 extranet. The correct software version must be flashed to the MCU. The user must access the Dana TM4 Extranet to determine which software versions are compatible with the particular MCU
4. The MCU is defective, because the factory setting may be wrong. In this case, the MCU must be replaced.

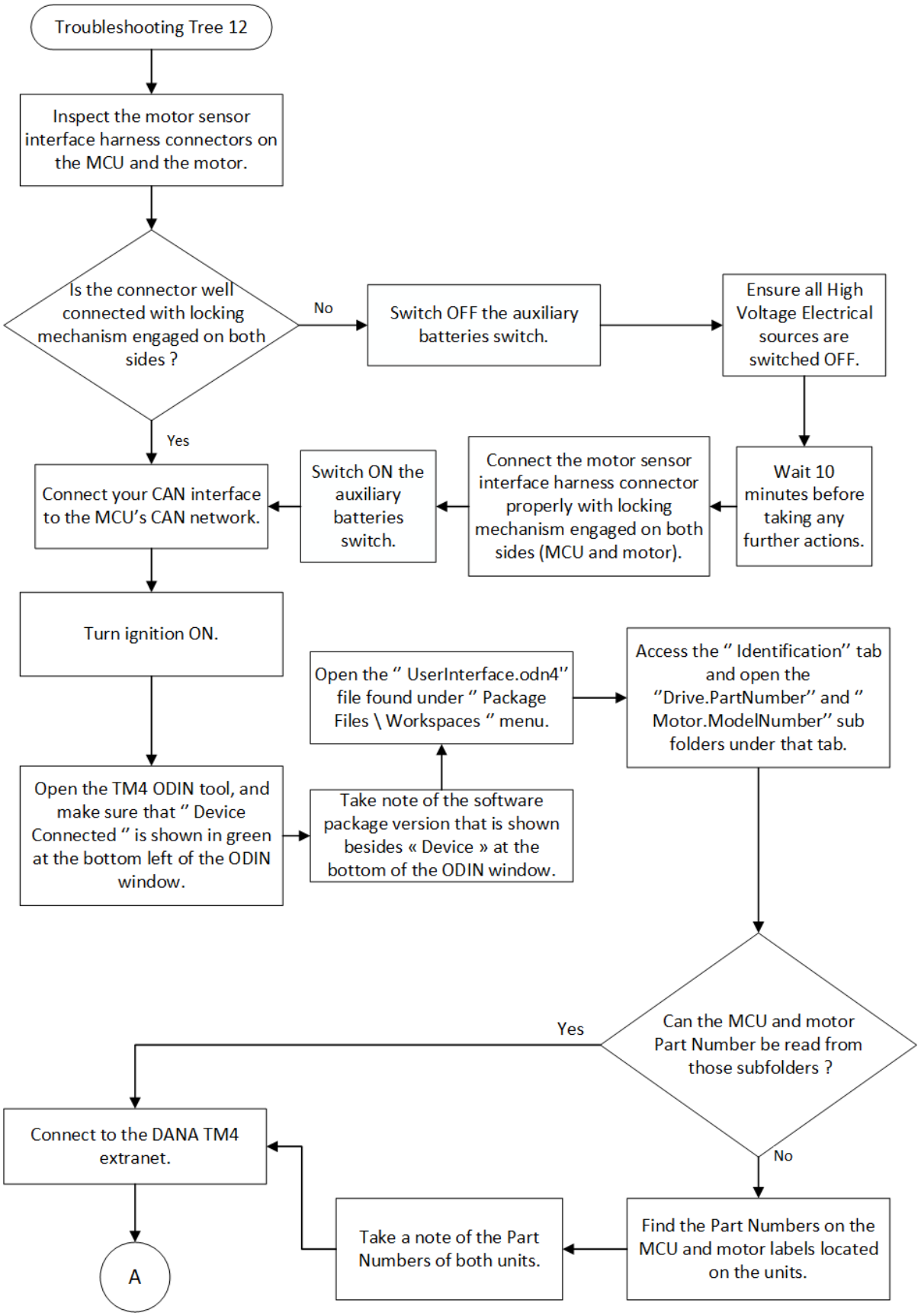
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

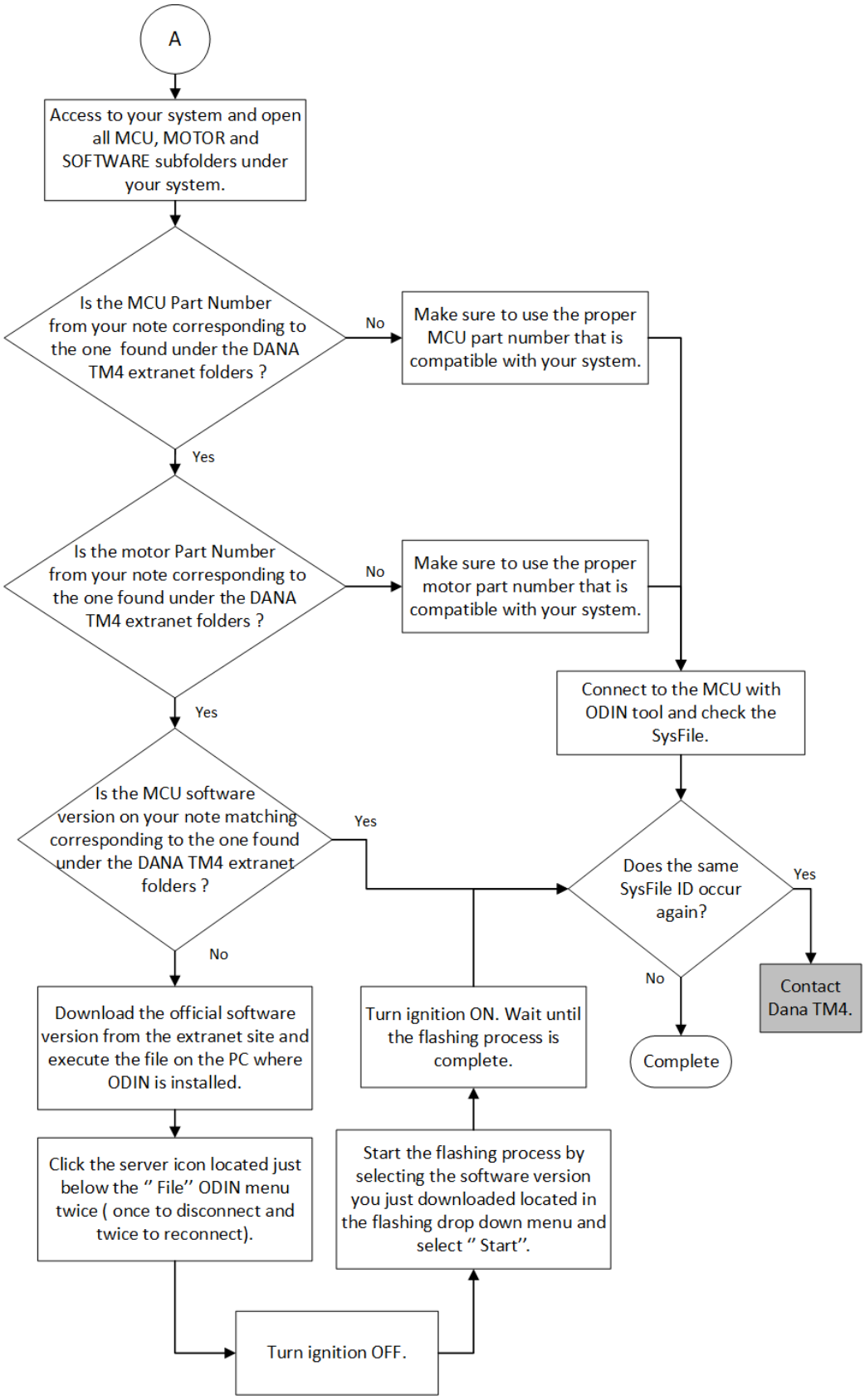
See "Safety Warnings" and "Troubleshooting Tips" sections for general guidelines on system diagnostics.

Related Process

The TT12 call the following process:

- Appendix 6: Update Software


Troubleshooting Tree 12
Inspect the motor sensor interface harness connectors on the MCU and the motor.
Is the connector well connected with locking mechanism engaged on both sides ?
No
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait 10 minutes before taking any further actions.
Connect the motor sensor interface harness connector properly with locking mechanism engaged on both sides (MCU and motor).
Switch ON the auxiliary batteries switch.
Yes
Connect your CAN interface to the MCU's CAN network.
Turn ignition ON.
Open the TM4 ODIN tool, and make sure that " Device Connected " is shown in green at the bottom left of the ODIN window.
Take note of the software package version that is shown besides « Device » at the bottom of the ODIN window.
Open the " UserInterface.odn4" file found under " Package Files \ Workspaces " menu.
Access the " Identification" tab and open the "Drive.PartNumber" and " Motor.ModelNumber" sub folders under that tab.
Can the MCU and motor Part Number be read from those subfolders ?
Yes
No
Find the Part Numbers on the MCU and motor labels located on the units.
Take a note of the Part Numbers of both units.
Connect to the DANA TM4 extranet.
A


A
Access to your system and open all MCU, MOTOR and SOFTWARE subfolders under your system.
Is the MCU Part Number from your note corresponding to the one found under the DANA TM4 extranet folders ?
No
Make sure to use the proper MCU part number that is compatible with your system.
Yes
Is the motor Part Number from your note corresponding to the one found under the DANA TM4 extranet folders ?
No
Make sure to use the proper motor part number that is compatible with your system.
Yes
Connect to the MCU with ODIN tool and check the SysFile.
Is the MCU software version on your note matching corresponding to the one found under the DANA TM4 extranet folders ?
Yes
Does the same SysFile ID occur again?
Yes
Contact Dana TM4.
No
Complete
No
Download the official software version from the extranet site and execute the file on the PC where ODIN is installed.
Turn ignition ON. Wait until the flashing process is complete.
Click the server icon located just below the " File" ODIN menu twice (once to disconnect and twice to reconnect).
Start the flashing process by selecting the software version you just downloaded located in the flashing drop down menu and select " Start".
Turn ignition OFF.

TT13: Invalid Motor Type or Phase Calibration

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x120A 0x3212	Invalid motor type or phase calibration.	**1.** Third party motor not calibrated. **2.** Defective motor.

Description

The Troubleshooting Tree 13 indicates an error where the Initialization of the Motor Control Unit (MCU) timed out, and couldn't be completed.

Listed below are the possible causes of these SysFile IDs, in order of likelihood:

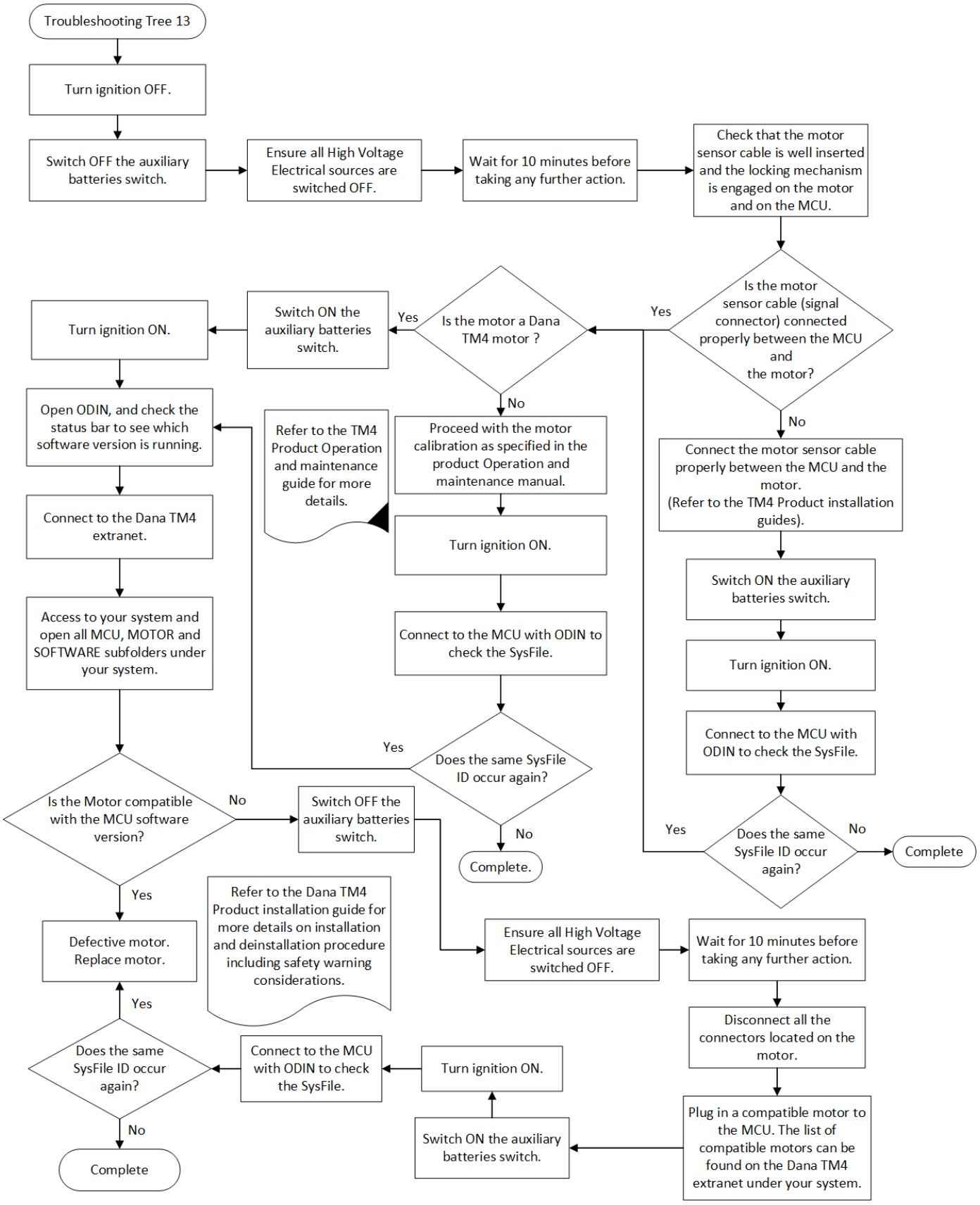
1. The integration is using a third-party motor, which is not correctly calibrated. The user must check the Operations and Maintenance Guide to see how to calibrate the third-party motor.
2. The motor is defective. In this case, the system must be turned off, and the motor must be disconnected and replaced.

Note: Refer to the TM4 motor installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: Refer to the TM4 Product installation guide (MCU and motor) for more details on installation regarding the motor sensor connection between the MCU and the motor

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See "Safety Warnings" and "Troubleshooting Tips" sections for general guidelines on system diagnostics.


Troubleshooting Tree 13
Turn ignition OFF.
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Check that the motor sensor cable is well inserted and the locking mechanism is engaged on the motor and on the MCU.
Is the motor sensor cable (signal connector) connected properly between the MCU and the motor?
Yes
No
Connect the motor sensor cable properly between the MCU and the motor. (Refer to the TM4 Product installation guides).
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete
Is the motor a Dana TM4 motor ?
Yes
No
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Proceed with the motor calibration as specified in the product Operation and maintenance manual.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete.
Refer to the TM4 Product Operation and maintenance guide for more details.
Open ODIN, and check the status bar to see which software version is running.
Connect to the Dana TM4 extranet.
Access to your system and open all MCU, MOTOR and SOFTWARE subfolders under your system.
Is the Motor compatible with the MCU software version?
No
Yes
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Disconnect all the connectors located on the motor.
Plug in a compatible motor to the MCU. The list of compatible motors can be found on the Dana TM4 extranet under your system.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete
Defective motor. Replace motor.
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT14: Invalid Hardware Version

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x3307 0x2209	The control detect that the motor connected to the MCU is not compatible with the MCU software package.	**1.** Wrong motor type connected to the MCU. **2.** Wrong software flashed to the MCU. **3.** Defective Motor

Description

The Troubleshooting Tree 14 indicates an error where the motor connected to the Motor Control Unit is not compatible with the software version that the Motor Control Unit (MCU) is running.

Listed below are the possible causes of these SysFile IDs, in order of likelihood:

1. The type of motor connected to the MCU is not compatible. In this case, the user must turn off the system and disconnect and replace the motor.
2. The software version flashed to the MCU was incorrect. In this case, the user must go to the Dana TM4 extranet to find a compatible software version, and then flash it to the MCU. Refer to the Appendix 6: Update Software for the procedure to do this.
3. The motor itself may be defective.

Note: Refer to the TM4 motor installation guide for more details on installation and deinstallation procedure including safety warning considerations.

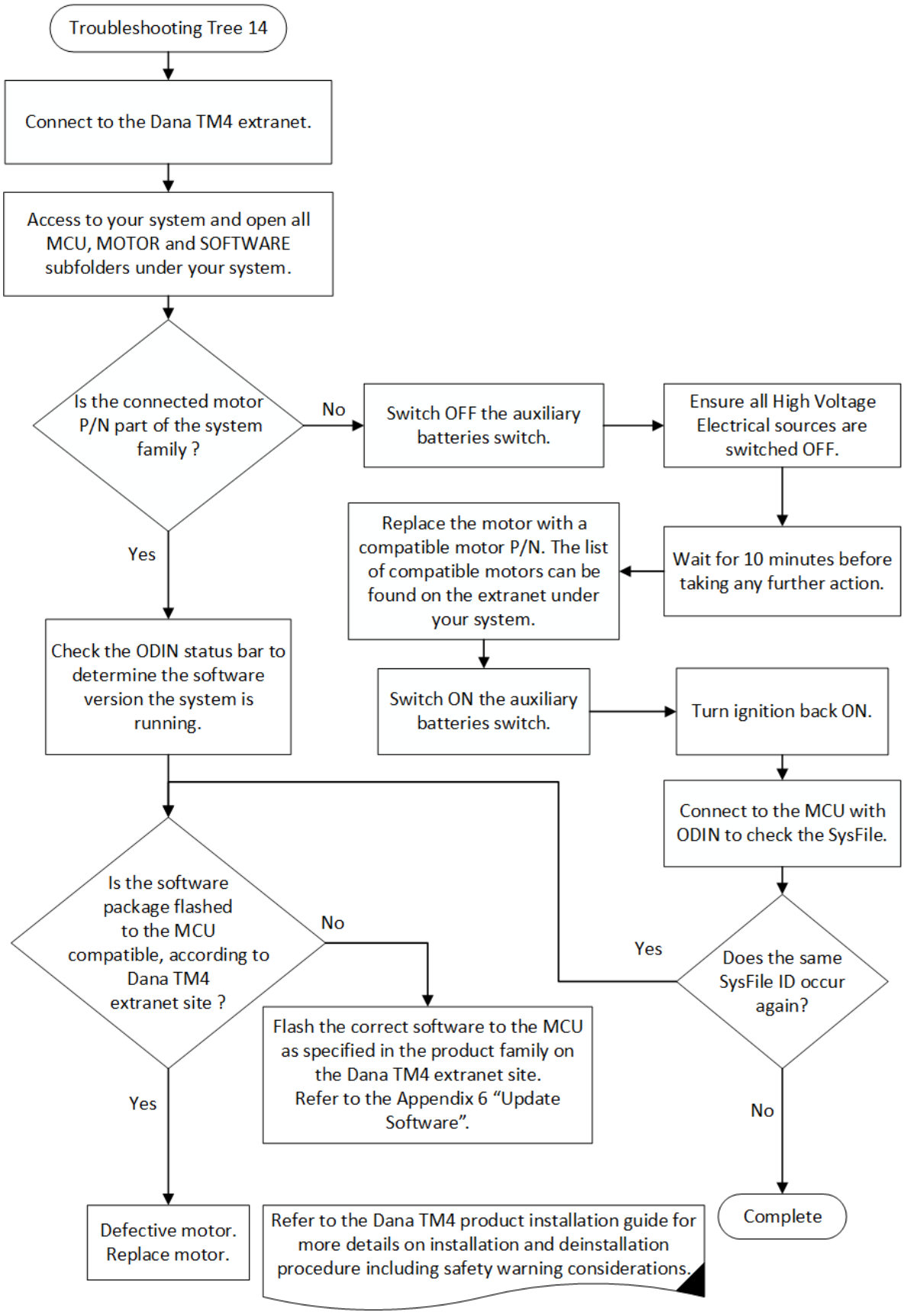
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting procedure tree below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Related Process

The TT14 call the following process:

- Appendix 6: Update Software


Troubleshooting Tree 14
Connect to the Dana TM4 extranet.
Access to your system and open all MCU, MOTOR and SOFTWARE subfolders under your system.
Is the connected motor P/N part of the system family ?
No
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Replace the motor with a compatible motor P/N. The list of compatible motors can be found on the extranet under your system.
Switch ON the auxiliary batteries switch.
Turn ignition back ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete
Yes
Check the ODIN status bar to determine the software version the system is running.
Is the software package flashed to the MCU compatible, according to Dana TM4 extranet site ?
No
Flash the correct software to the MCU as specified in the product family on the Dana TM4 extranet site. Refer to the Appendix 6 "Update Software".
Yes
Defective motor. Replace motor.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT15: Inconsistence of Protected EEPROM memory section

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x1000 0x1100 0x1200	Inconsistency of the Protected, Global or ParamDrv EEPROM memory section has been detected through a CRC verification.	**1.** Defective MCU.

Description

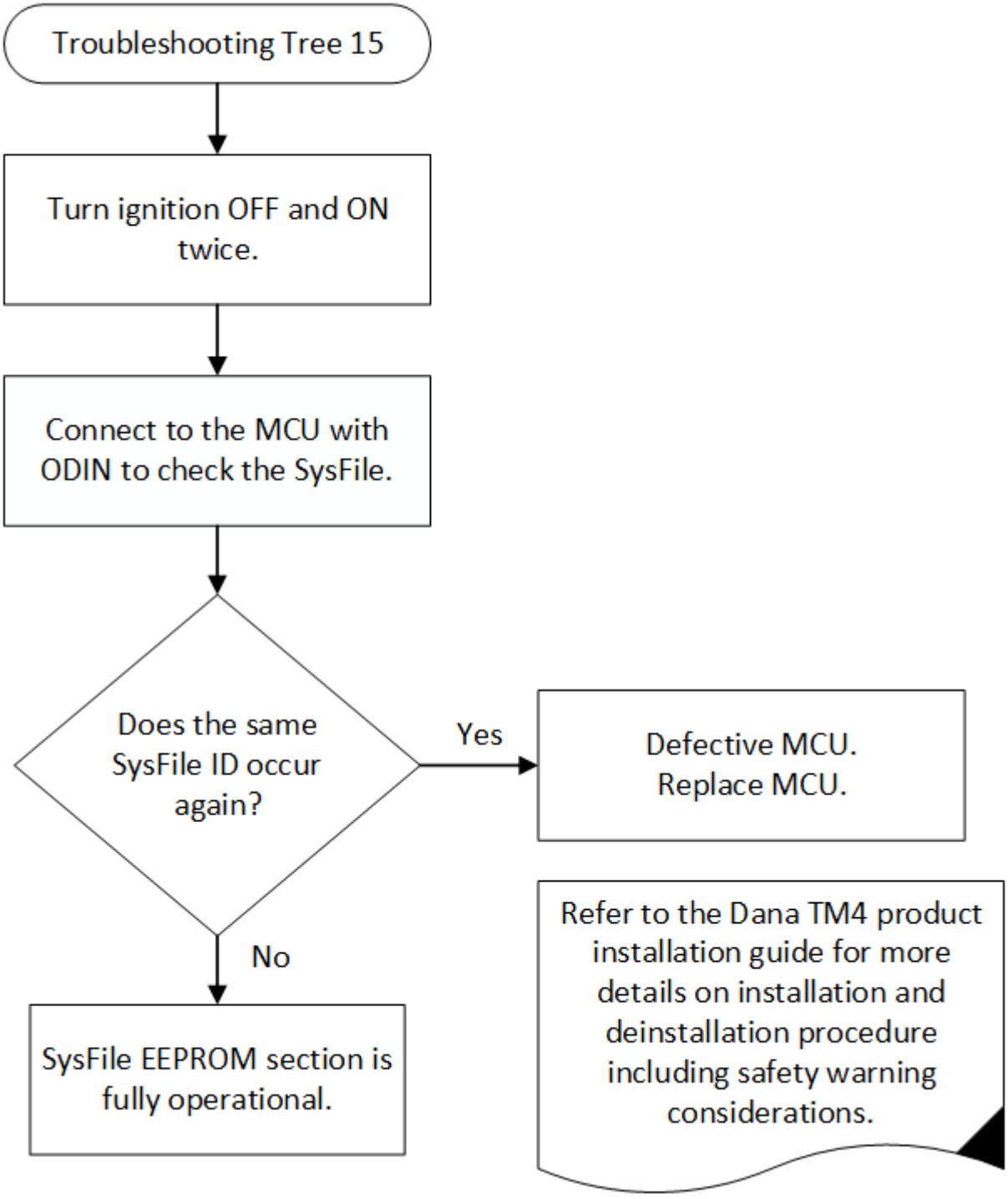
The Troubleshooting Tree 15 indicates an error where an inconsistency in the protected, global or ParamDrv EEPROM memory section was detected through Cyclic Redundancy Check (CRC) validation.

The possible cause of this SysFile ID may be the defective MCU. In this case, the MCU must be turned OFF and be disconnected and replaced.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 15
Turn ignition OFF and ON twice.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
No
SysFile EEPROM section is fully operational.

TT16: Invalid Hardware or Software

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x1003 0x3301	The application software flashed to the MCU is not compatible with the MCU hardware configured in factory.	**1.** Wrong software flashed to the MCU unit (not compatible with MCU P/N). **2.** Wrong MCU P/N unit used with flashed software. **3.** Defective MCU (Potential wrong factory setting).

Description

The Troubleshooting Tree 16 indicates an error where the application software that was flashed to the Motor Control Unit is not compatible with the hardware configuration of the Motor Control Unit (MCU).

Listed below are the possible causes of these SysFile IDs, in order of likelihood:

1. The wrong software was flashed to the MCU, which was not compatible with the hardware's specific configuration. In this case, the user must access the Dana TM4 extranet to determine the compatibility of the software and the hardware, and determine which software version must be used.
2. The wrong MCU part number was used with the flashed software. In this case, the user must use a different MCU.
3. The MCU is defective because the factory settings are wrong. In this case, the MCU must be turned OFF and be disconnected and replaced.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: Replace the MCU with a MCU corresponding to the MCU subfolder specified on the Dana TM4 extranet site.

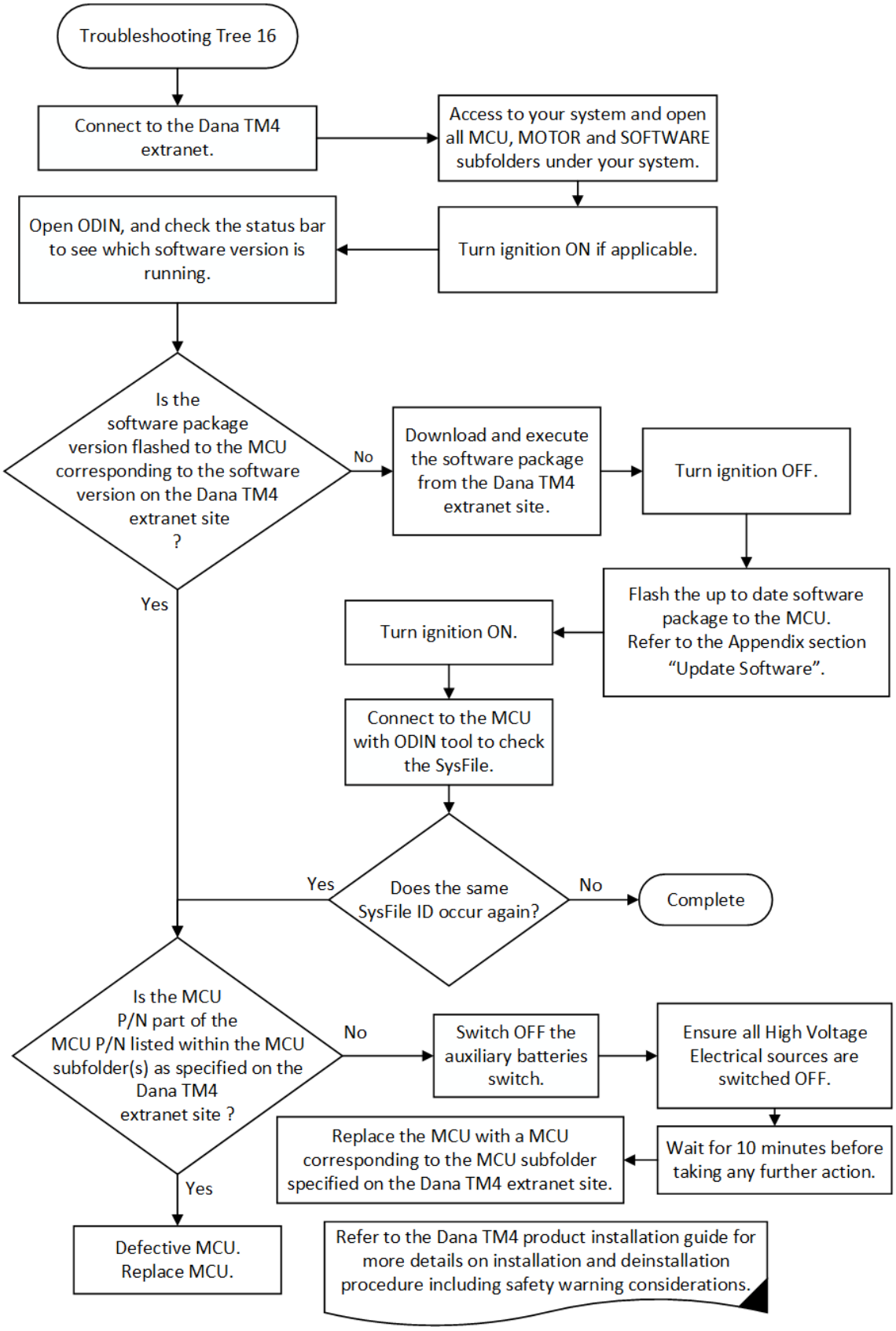
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See "Safety Warnings" and "Troubleshooting Tips" sections for general guidelines on system diagnostics.

Related Process

The TT16 call the following process:

- Appendix 6: Update Software


Troubleshooting Tree 16
Connect to the Dana TM4 extranet.
Access to your system and open all MCU, MOTOR and SOFTWARE subfolders under your system.
Turn ignition ON if applicable.
Open ODIN, and check the status bar to see which software version is running.
Is the software package version flashed to the MCU corresponding to the software version on the Dana TM4 extranet site ?
No
Download and execute the software package from the Dana TM4 extranet site.
Turn ignition OFF.
Flash the up to date software package to the MCU. Refer to the Appendix section "Update Software".
Turn ignition ON.
Connect to the MCU with ODIN tool to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete
Yes
Is the MCU P/N part of the MCU P/N listed within the MCU subfolder(s) as specified on the Dana TM4 extranet site ?
No
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Replace the MCU with a MCU corresponding to the MCU subfolder specified on the Dana TM4 extranet site.
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT17: Inconsistence between Control Logic and IGBT

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x3100 0x3101 0x3102 0x3103 0x3104 0x3105 0x3106 0x3107 0x3108	Inconsistency between the internal control logic and the turn ON of IGBT of phase #1 to phase # 9 respectively.	**1.** Minor issue. Could potentially be raised due to internal noise under high DC input voltage level. **2.** Defective MCU, if 0x320D SysFile ID also occurs within the same power up. **3.** Defective MCU, if 0x3200 to 0x3208 SysFile ID also occurs within the same power up.

Description

The Troubleshooting Tree 17 indicates an error where there is an inconsistency between the internal control logic of the MCU and the activation of the IGBT of one or more phases.

Listed below are the possible causes of these SysFile IDs, in order of likelihood:

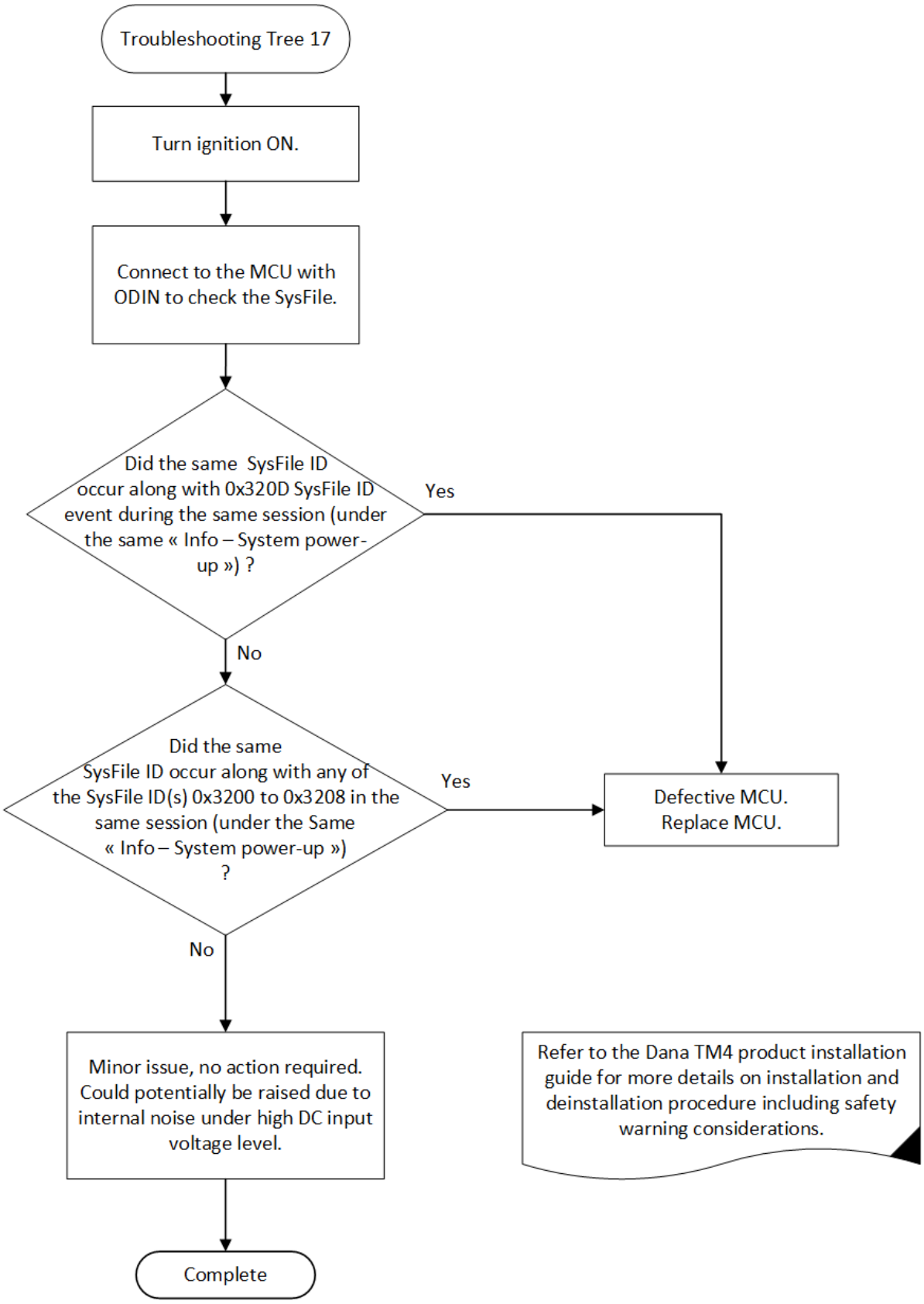
1. It may be a minor issue, and may be seen because of internal noise, and no action may be needed.
2. The MCU may be defective. In this case, the MCU must be turned OFF and the MCU must be disconnected and replaced.

This event indicates inconsistency between the internal control logic and the turn ON of IGBT of the related phase.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 17
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Did the same SysFile ID occur along with 0x320D SysFile ID event during the same session (under the same « Info – System power-up ») ?
Yes
No
Did the same SysFile ID occur along with any of the SysFile ID(s) 0x3200 to 0x3208 in the same session (under the Same « Info – System power-up ») ?
Yes
Defective MCU. Replace MCU.
No
Minor issue, no action required. Could potentially be raised due to internal noise under high DC input voltage level.
Complete
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT18: High power battery voltage < lower voltage limit

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x310A	The high-power DC voltage dropped under the limit and caused the system to go in a fault state.	**1.** DC high power contactor issue. **2.** DC high power battery source issue. **3.** DC high power battery chain connection issue (contactor, PDU, pre-charge circuit and MCU, BMS). **4.** Improper grounding (MCU and / or motor). **5.** DC system load activation/deactivation. **6.** Defective controller. **7.** Defective MCU.

Description

The Troubleshooting Tree 18 indicates an error where the High-Power DC voltage drops lower than the limit (300V), which the caused system to go in a defective state.

Listed below are the possible causes of the SysFile ID, in order of likelihood:

1. Something is wrong with the main contactors of the lines from the DC high power battery.
2. There is an issue with the DC high power battery source. The user must consult the manual related to the DC high voltage battery.
3. DC high power battery chain connection issue (contactor, PDU, pre-charge circuit and MCU, BMS). Check the continuity along the cables from MCU to High Voltage Battery pack. If there is continuity fault, replace the wirings.
4. There is an issue with the grounding. In this case, the system must be turned OFF and the grounding connections must be checked. If they are defective, replace the grounding wirings.
5. There are additional loads on board the vehicle that might trig the SysFile ID. Refer to the potential external causes list in the Note.
6. Connect TM4 ODIN to check if these SysFile IDs occur again. If this is the case, the MCU is defective. Turn Ignition OFF and all high voltage electrical sources before replacing MCU.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations

Note: List of potential external causes:

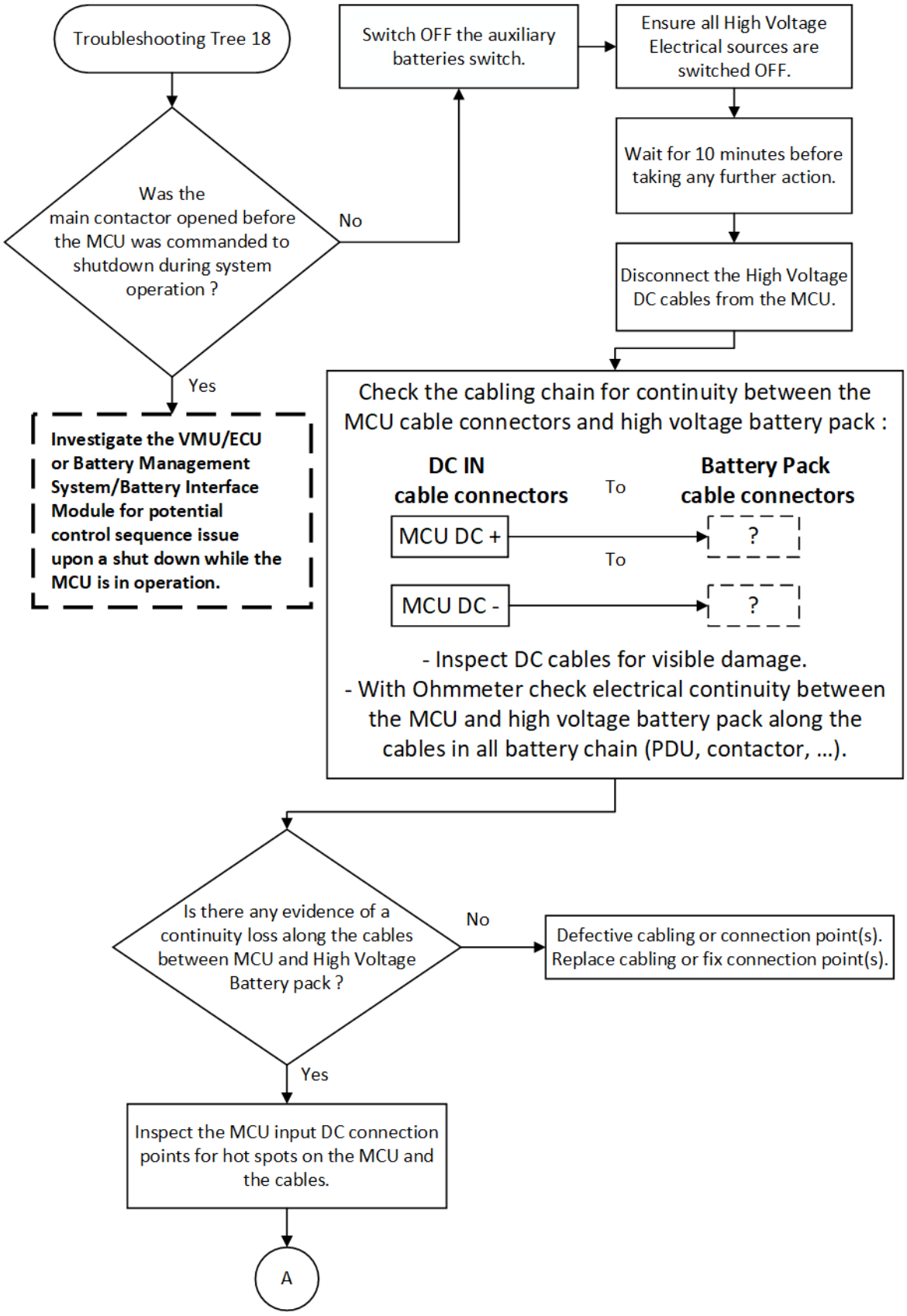
- Another defective system on the DC bus causing electrical overloads,
- Defective Battery Management System or Battery Interface Module,
- Defective battery contactor causing intermittent contact,
- Defective controller VMU/ECU,
- Higher than normal High Voltage battery level,
- Defective Power Distribution Unit or connection between MCU and Power Distribution Unit,
- Defective battery charger.

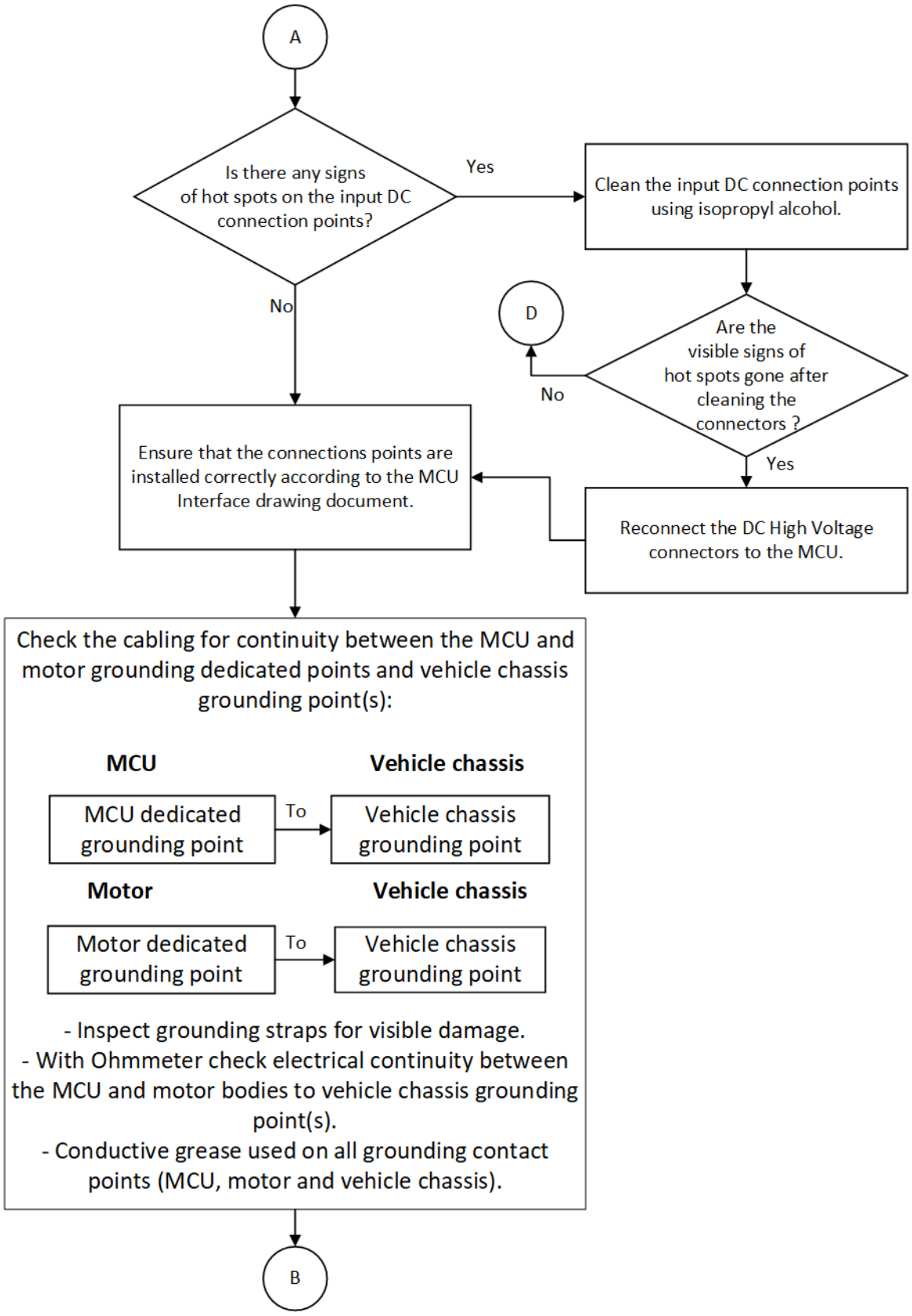
Refer to the related Service Manual of these listed systems.

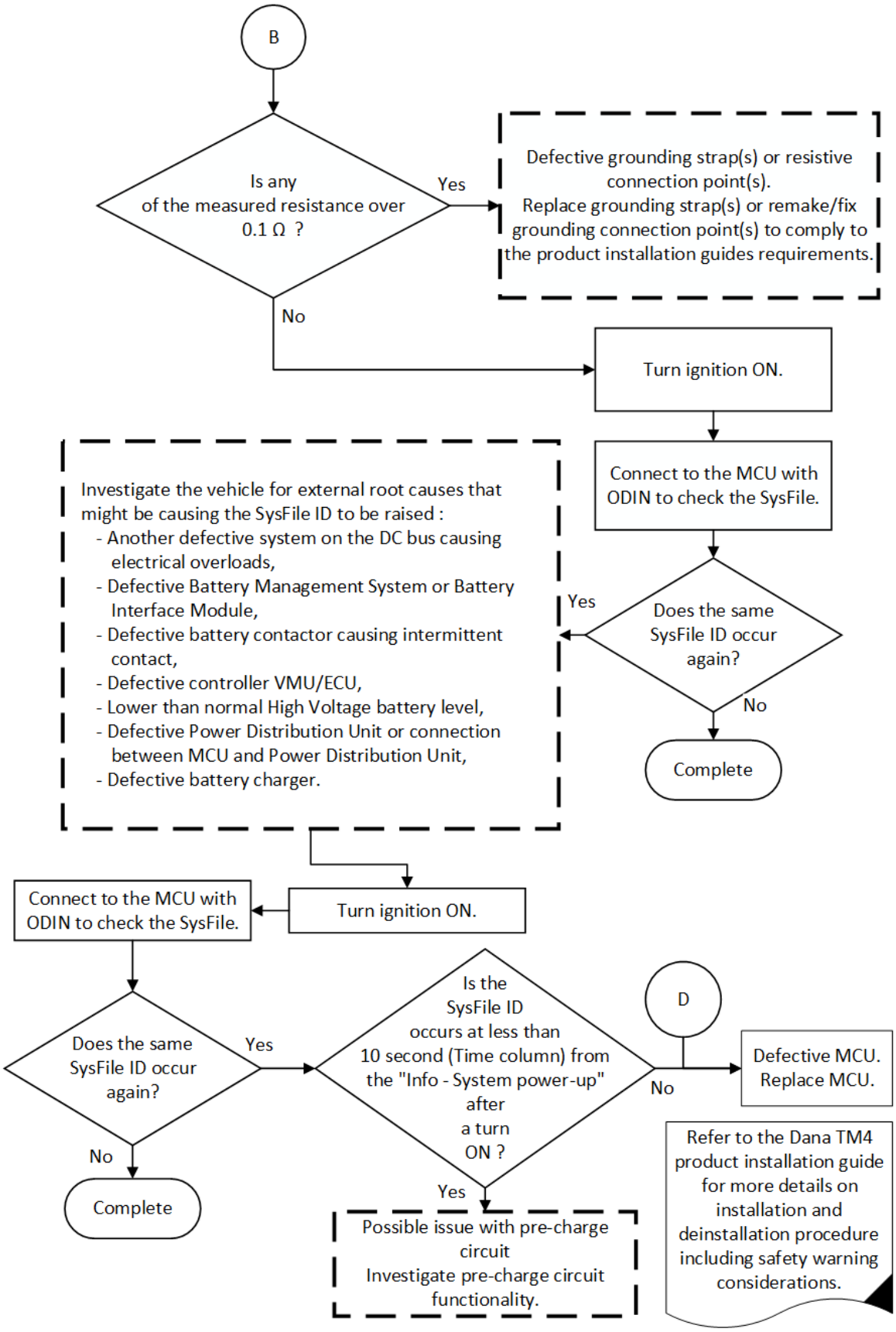
Note: Refer to the Battery Pack Troubleshooting Guide to get the pinout of the related Battery Pack connector to perform the correct continuity check.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 18
Was the main contactor opened before the MCU was commanded to shutdown during system operation ?
No
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Disconnect the High Voltage DC cables from the MCU.
Yes
Investigate the VMU/ECU or Battery Management System/Battery Interface Module for potential control sequence issue upon a shut down while the MCU is in operation.
Check the cabling chain for continuity between the MCU cable connectors and high voltage battery pack :
DC IN cable connectors
To
Battery Pack cable connectors
MCU DC +
To
?
MCU DC -
?
- Inspect DC cables for visible damage.
- With Ohmmeter check electrical continuity between the MCU and high voltage battery pack along the cables in all battery chain (PDU, contactor, ...).
Is there any evidence of a continuity loss along the cables between MCU and High Voltage Battery pack ?
No
Defective cabling or connection point(s). Replace cabling or fix connection point(s).
Yes
Inspect the MCU input DC connection points for hot spots on the MCU and the cables.
A


A
Is there any signs of hot spots on the input DC connection points?
Yes
Clean the input DC connection points using isopropyl alcohol.
No
D
Are the visible signs of hot spots gone after cleaning the connectors ?
No
Yes
Ensure that the connections points are installed correctly according to the MCU Interface drawing document.
Reconnect the DC High Voltage connectors to the MCU.
Check the cabling for continuity between the MCU and motor grounding dedicated points and vehicle chassis grounding point(s):
MCU
Vehicle chassis
MCU dedicated grounding point
To
Vehicle chassis grounding point
Motor
Vehicle chassis
Motor dedicated grounding point
To
Vehicle chassis grounding point
- Inspect grounding straps for visible damage.
- With Ohmmeter check electrical continuity between the MCU and motor bodies to vehicle chassis grounding point(s).
- Conductive grease used on all grounding contact points (MCU, motor and vehicle chassis).
B


B
Is any of the measured resistance over 0.1 Ω ?
Yes
Defective grounding strap(s) or resistive connection point(s). Replace grounding strap(s) or remake/fix grounding connection point(s) to comply to the product installation guides requirements.
No
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
Investigate the vehicle for external root causes that might be causing the SysFile ID to be raised :
- Another defective system on the DC bus causing electrical overloads,
- Defective Battery Management System or Battery Interface Module,
- Defective battery contactor causing intermittent contact,
- Defective controller VMU/ECU,
- Lower than normal High Voltage battery level,
- Defective Power Distribution Unit or connection between MCU and Power Distribution Unit,
- Defective battery charger.
No
Complete
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete
Is the SysFile ID occurs at less than 10 second (Time column) from the "Info - System power-up" after a turn ON ?
Yes
Possible issue with pre-charge circuit
Investigate pre-charge circuit functionality.
No
D
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT19: High Power Battery Voltage > Maximum

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x310B 0x310C	High power DC voltage was higher than the limit.	**1.** "BlackBox info available" is not displayed in the status bar at the bottom of the window in TM4 ODIN tool **2.** Significant voltage drops meaning numerous repeated connections and reconnections. **3.** Affected motor resolver signal (motor angle waveform) that creates DC high voltage ripple. **4.** Continuity fault between the MCU grounding port and the ground. **5.** Another external root causes. **6.** Defective MCU.

Description

The troubleshooting tree 19 indicates an error where the high power DC battery voltage reaches over voltage limit and causes MCU defective state.

Listed below are the possible artifacts of these SysFile IDs in order of likelihood:

1. The text "BlackBox info available" is not displayed in the status bar at the bottom of the window in TM4 ODIN tool.
2. There were significant voltage drops within the BlackBox view meaning there were numerous repeated connections and reconnections.
3. The motor resolver angle waveform shows ripples. See the note and the pictures on the next page.
4. There is continuity fault between the MCU grounding port and the ground.
5. There is continuity fault between the shield portion DC cables connected to the DC cable glands assemblies (positive and negative cables).
6. Another external root causes.
7. Connect TM4 ODIN to check these SysFile IDs occur again. If this is the case, the MCU is defective.

Note: The DC high battery power lines have a contactors issue. Turn Ignition off before investigation of the contactors. For the investigation refer to the relevant contactor documentation.

Note: The DC high voltage supply is intermittent. Turn Ignition off before the investigation of the DC battery chain from the contactor to the MCU.

Note: There are resonance within the DC lines or the regeneration torque causes increase in voltage because of battery resistance or the motor resolver is making a voltage ripple.

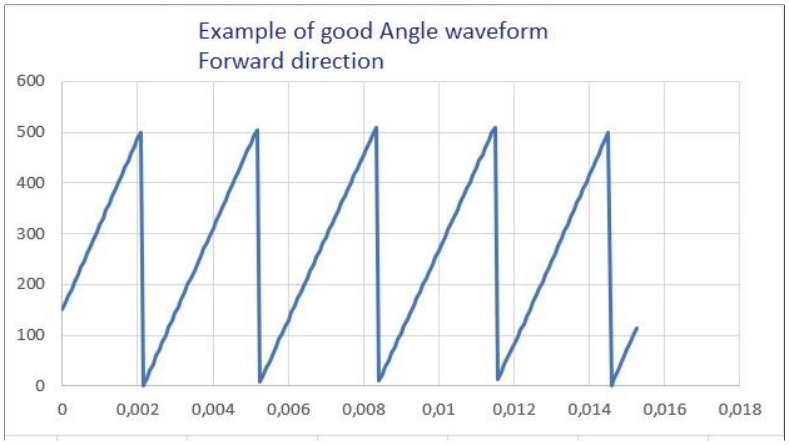
Note: Regarding contact intermittence to MCU, if the contactor contacts or any other contacts in the battery chain from contactor to MCU are intermittent while the MCU is in operational state, it could make the DC bus to fluctuate due to resonances on the DC line beyond the high voltage detection point.

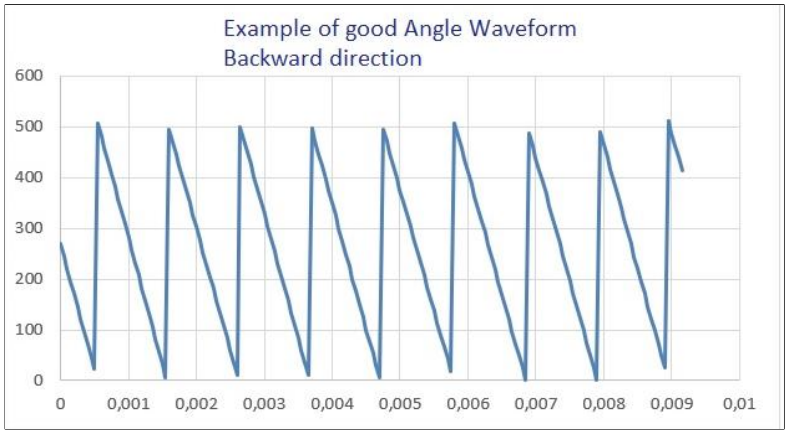
Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Note: Refer to the TM4 Product installation guides for more details on grounding (MCU and motor).

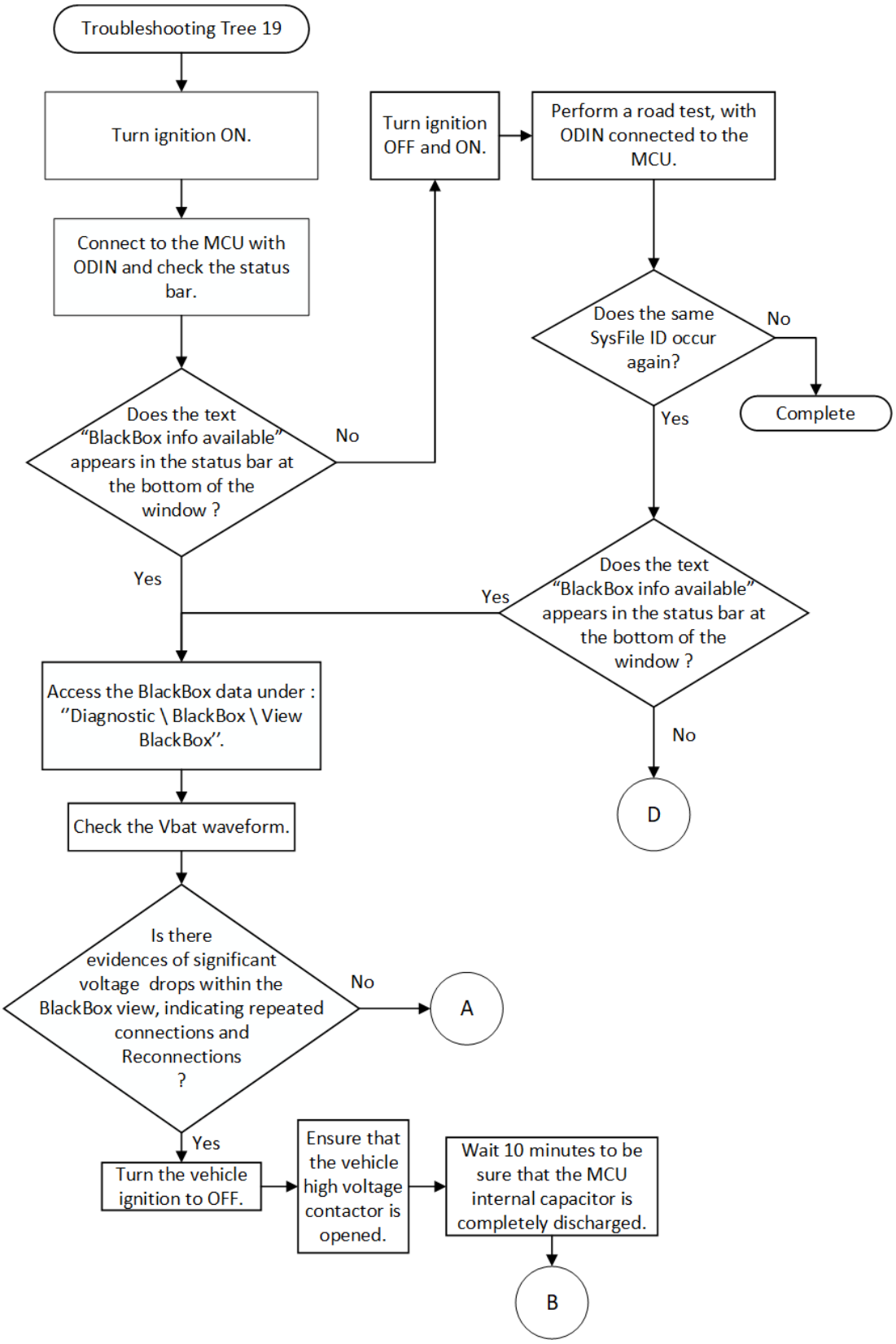
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

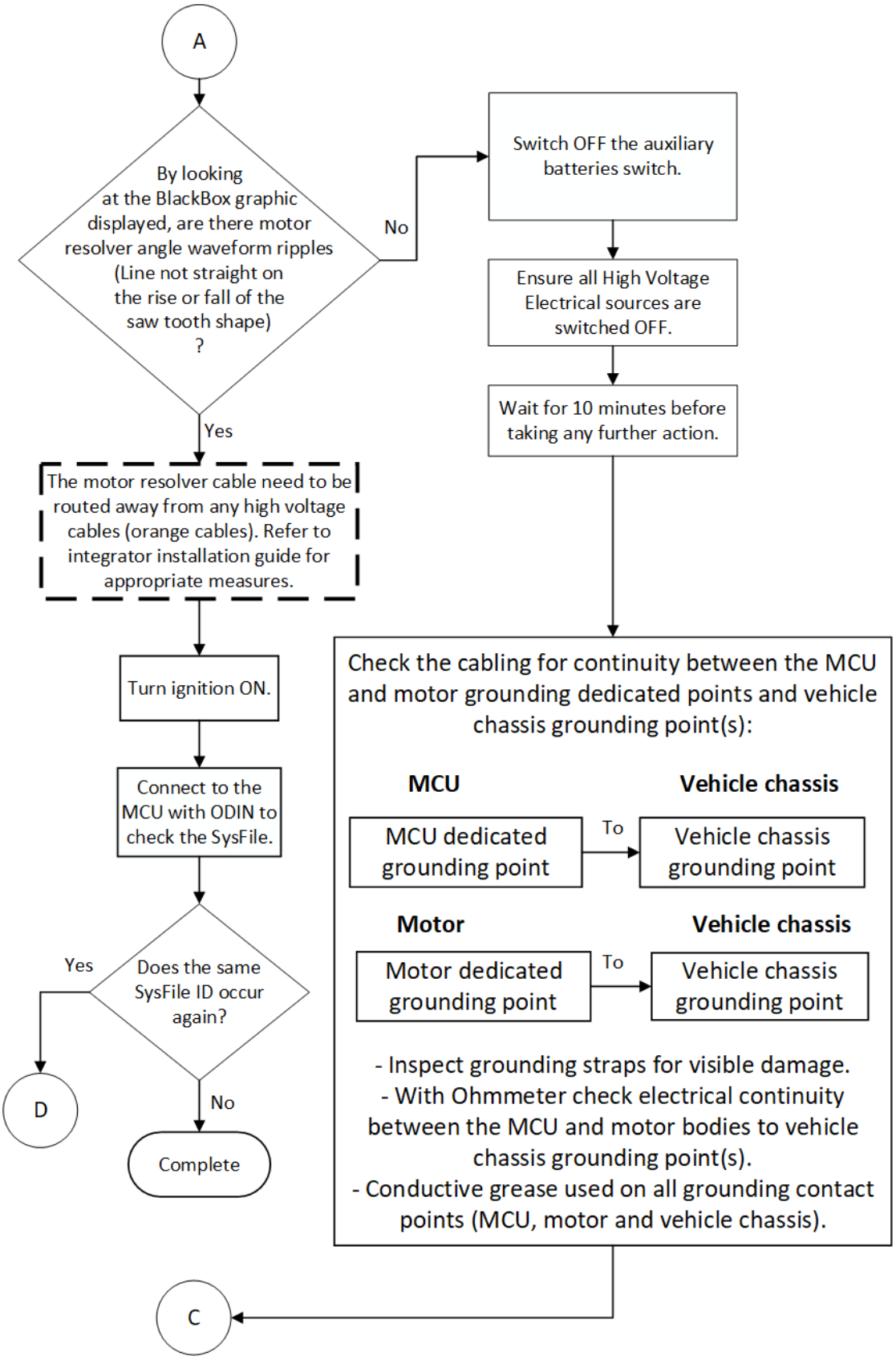
See "Safety Warnings" and "Troubleshooting Tips" sections for general guidelines on system diagnostics.

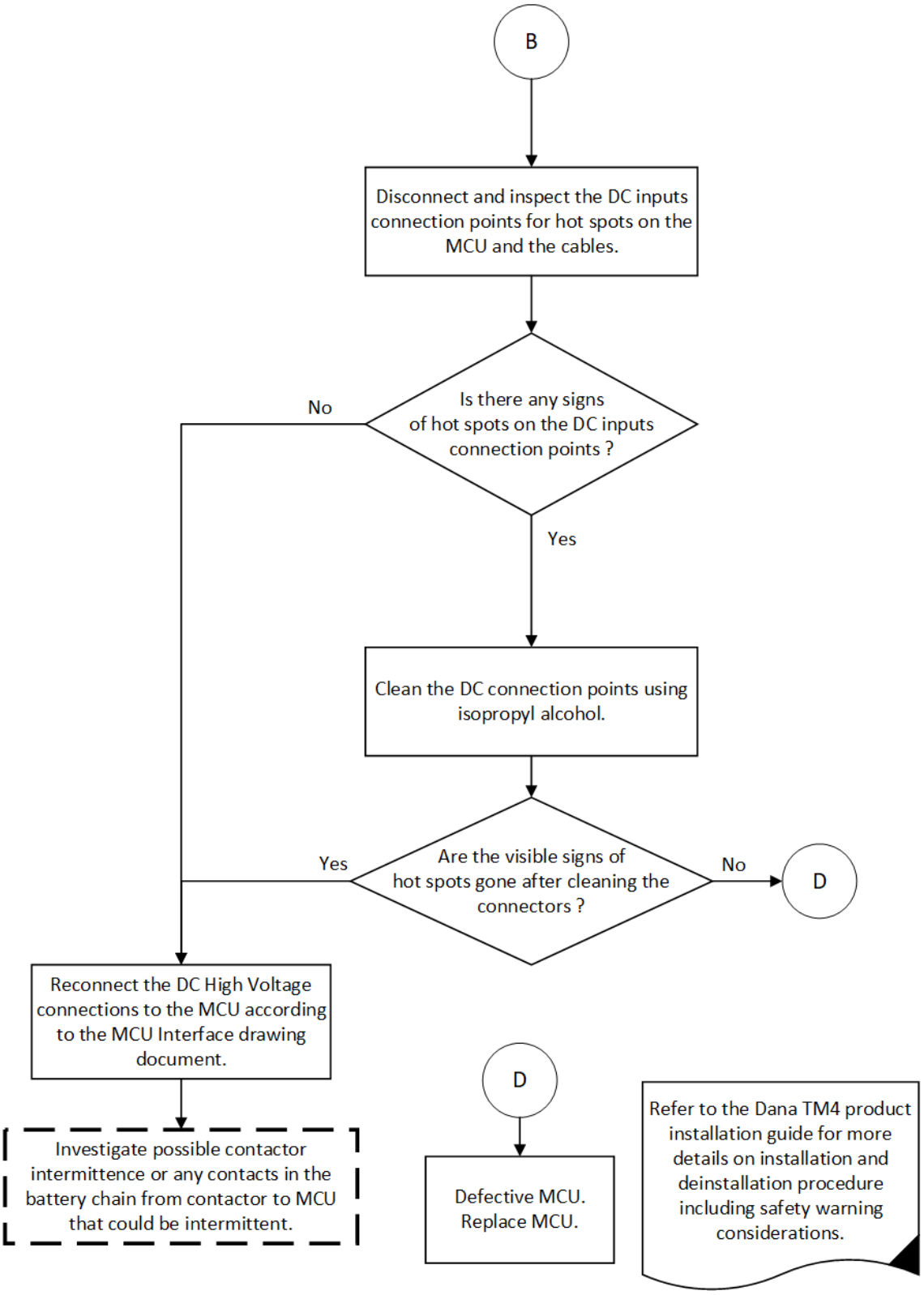
Note: Regarding the resolver angle waveform, if the MCU goes in faulty state, it will capture a BlackBox upon the reported error(s).
The BlackBox can then be consulted via ODIN tool to see if the angle waveform (saw tooth) is straight on each rising and falling edges.
See below examples of waveform.

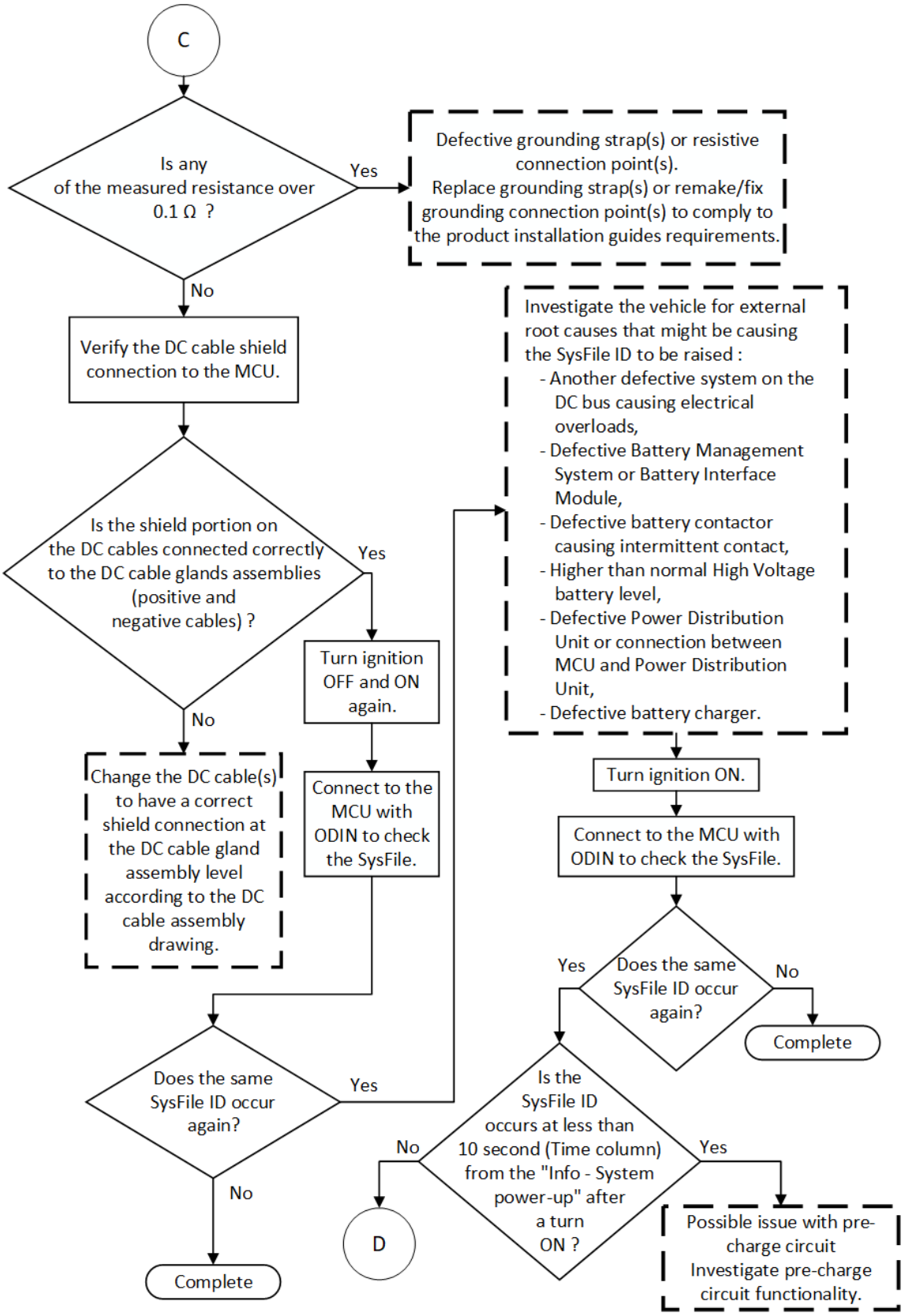





Troubleshooting Tree 19
Turn ignition ON.
Connect to the MCU with ODIN and check the status bar.
Does the text "BlackBox info available" appears in the status bar at the bottom of the window ?
No
Yes
Turn ignition OFF and ON.
Perform a road test, with ODIN connected to the MCU.
Does the same SysFile ID occur again?
No
Complete
Yes
Does the text "BlackBox info available" appears in the status bar at the bottom of the window ?
Yes
No
D
Access the BlackBox data under : "Diagnostic \ BlackBox \ View BlackBox".
Check the Vbat waveform.
Is there evidences of significant voltage drops within the BlackBox view, indicating repeated connections and Reconnections ?
No
A
Yes
Turn the vehicle ignition to OFF.
Ensure that the vehicle high voltage contactor is opened.
Wait 10 minutes to be sure that the MCU internal capacitor is completely discharged.
B


A
By looking at the BlackBox graphic displayed, are there motor resolver angle waveform ripples (Line not straight on the rise or fall of the saw tooth shape) ?
No
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Yes
The motor resolver cable need to be routed away from any high voltage cables (orange cables). Refer to integrator installation guide for appropriate measures.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
D
No
Complete
Check the cabling for continuity between the MCU and motor grounding dedicated points and vehicle chassis grounding point(s):
MCU
Vehicle chassis
MCU dedicated grounding point
To
Vehicle chassis grounding point
Motor
Vehicle chassis
Motor dedicated grounding point
To
Vehicle chassis grounding point
- Inspect grounding straps for visible damage.
- With Ohmmeter check electrical continuity between the MCU and motor bodies to vehicle chassis grounding point(s).
- Conductive grease used on all grounding contact points (MCU, motor and vehicle chassis).
C


B
Disconnect and inspect the DC inputs connection points for hot spots on the MCU and the cables.
Is there any signs of hot spots on the DC inputs connection points ?
No
Yes
Clean the DC connection points using isopropyl alcohol.
Are the visible signs of hot spots gone after cleaning the connectors ?
Yes
No
D
Reconnect the DC High Voltage connections to the MCU according to the MCU Interface drawing document.
Investigate possible contactor intermittence or any contacts in the battery chain from contactor to MCU that could be intermittent.
D
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.


C
Is any of the measured resistance over 0.1 Ω ?
Yes
Defective grounding strap(s) or resistive connection point(s). Replace grounding strap(s) or remake/fix grounding connection point(s) to comply to the product installation guides requirements.
No
Verify the DC cable shield connection to the MCU.
Is the shield portion on the DC cables connected correctly to the DC cable glands assemblies (positive and negative cables) ?
Yes
Turn ignition OFF and ON again.
Connect to the MCU with ODIN to check the SysFile.
No
Change the DC cable(s) to have a correct shield connection at the DC cable gland assembly level according to the DC cable assembly drawing.
Does the same SysFile ID occur again?
Yes
No
Complete
Investigate the vehicle for external root causes that might be causing the SysFile ID to be raised :
- Another defective system on the DC bus causing electrical overloads,
- Defective Battery Management System or Battery Interface Module,
- Defective battery contactor causing intermittent contact,
- Higher than normal High Voltage battery level,
- Defective Power Distribution Unit or connection between MCU and Power Distribution Unit,
- Defective battery charger.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete
Is the SysFile ID occurs at less than 10 second (Time column) from the "Info - System power-up" after a turn ON ?
No
D
Yes
Possible issue with pre-charge circuit Investigate pre-charge circuit functionality.

TT20: IGBT Temperature Sensor reading over the limit

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x310D 0x310E	One of the temperature sensors of the IGBT went over the limit and caused the system to go in a fault state.	**1.** Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit. **5.** Phase cable are damaged. **6.** Wrong torque applied to one or many phase lugs. **7.** Wrong phase cable crimping. **8.** Defective MCU.

Description

The Troubleshooting Tree 20 indicates an error where one of the temperature sensors had a reading where the temperature was higher than the allowed maximum temperature and causes MCU defective state.

Listed below are the possible artifacts of these SysFile IDs in order of likelihood:

1. The loss of the cooling circuit integrity. Refer to the Sub Troubleshooting Tree STT02 Verify Coolant integrity of the motor and MCU cooling circuit.
2. There are signs of burnt spots on the MCU contacts and on the phase cables. Or, the wrong torque was used on one or more of the phase lugs, and / or, the wrong phase cable crimping on one or more of the phase lugs.
3. Connect TM4 ODIN to check if these SysFile IDs occur again. If this is the case, the MCU is defective. Turn Ignition OFF and all high voltage electrical sources before replacing MCU.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: There is air in the cooling circuit. The air must be let out of the cooling circuit.

Note: The flow of the cooling liquid is too low to cool the motor. Refer to the cooling system troubleshooting Guide.

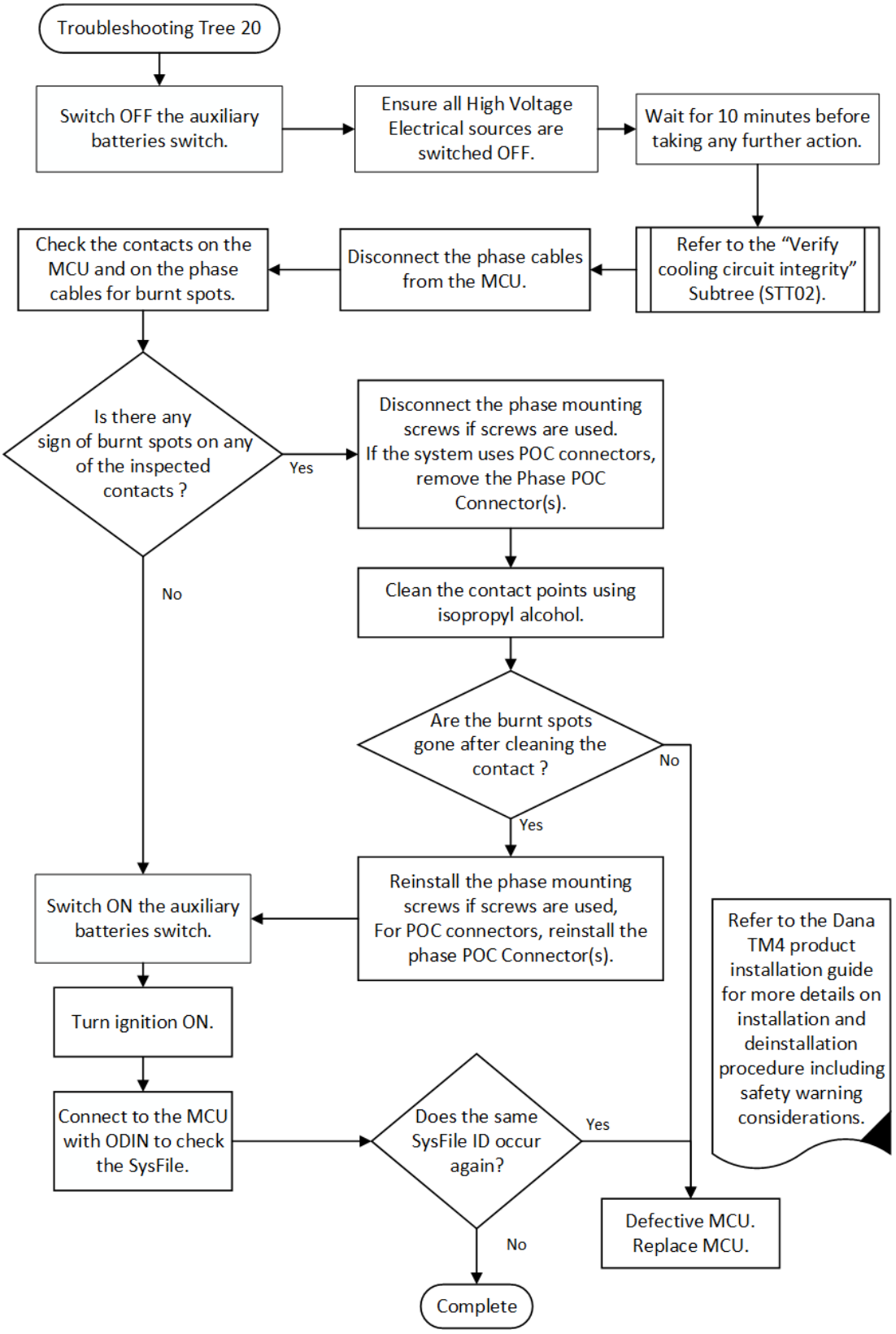
Note: The temperature of the liquid temperature is too high to cool the motor. The system must turn Ignition off and the coolant mixture must be replaced.

Note: The mixture of the cooling liquid was done badly, which does not let the coolant cool the motor. Replace the mixture of cooling liquid. Refer to the cooling system Service Manual.

Note: The wrong phase cable crimping on one or more of the phase lugs. Replace the cable.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 20
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Refer to the "Verify cooling circuit integrity" Subtree (STT02).
Disconnect the phase cables from the MCU.
Check the contacts on the MCU and on the phase cables for burnt spots.
Is there any sign of burnt spots on any of the inspected contacts ?
Yes
No
Disconnect the phase mounting screws if screws are used. If the system uses POC connectors, remove the Phase POC Connector(s).
Clean the contact points using isopropyl alcohol.
Are the burnt spots gone after cleaning the contact ?
No
Yes
Reinstall the phase mounting screws if screws are used, For POC connectors, reinstall the phase POC Connector(s).
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Defective MCU. Replace MCU.
Complete

TT21: Temperature Sensor reading over the limit

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x310F 0x3110	One of the internal temperature sensors went over the limit and caused the system to go in a failure state.	**1.** Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high. **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit. **5.** Defective MCU.

Description

The Troubleshooting Tree 21 indicates an error where one of the temperature sensors had a reading where the temperature was higher than the maximum limit and causes MCU defective state.

Listed below are the possible artifacts of this error, in order of likelihood:

1. The loss of the cooling circuit integrity. Refer to the Sub Troubleshooting Tree STT02 Verify Coolant integrity of the motor and MCU cooling circuit.
2. Connect TM4 ODIN to check if these SysFile IDs occur again. If this is the case, the MCU is defective. Turn Ignition OFF and all high voltage electrical sources before replacing MCU.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations

Note: There is air in the cooling circuit. The air must be let out of the cooling circuit.

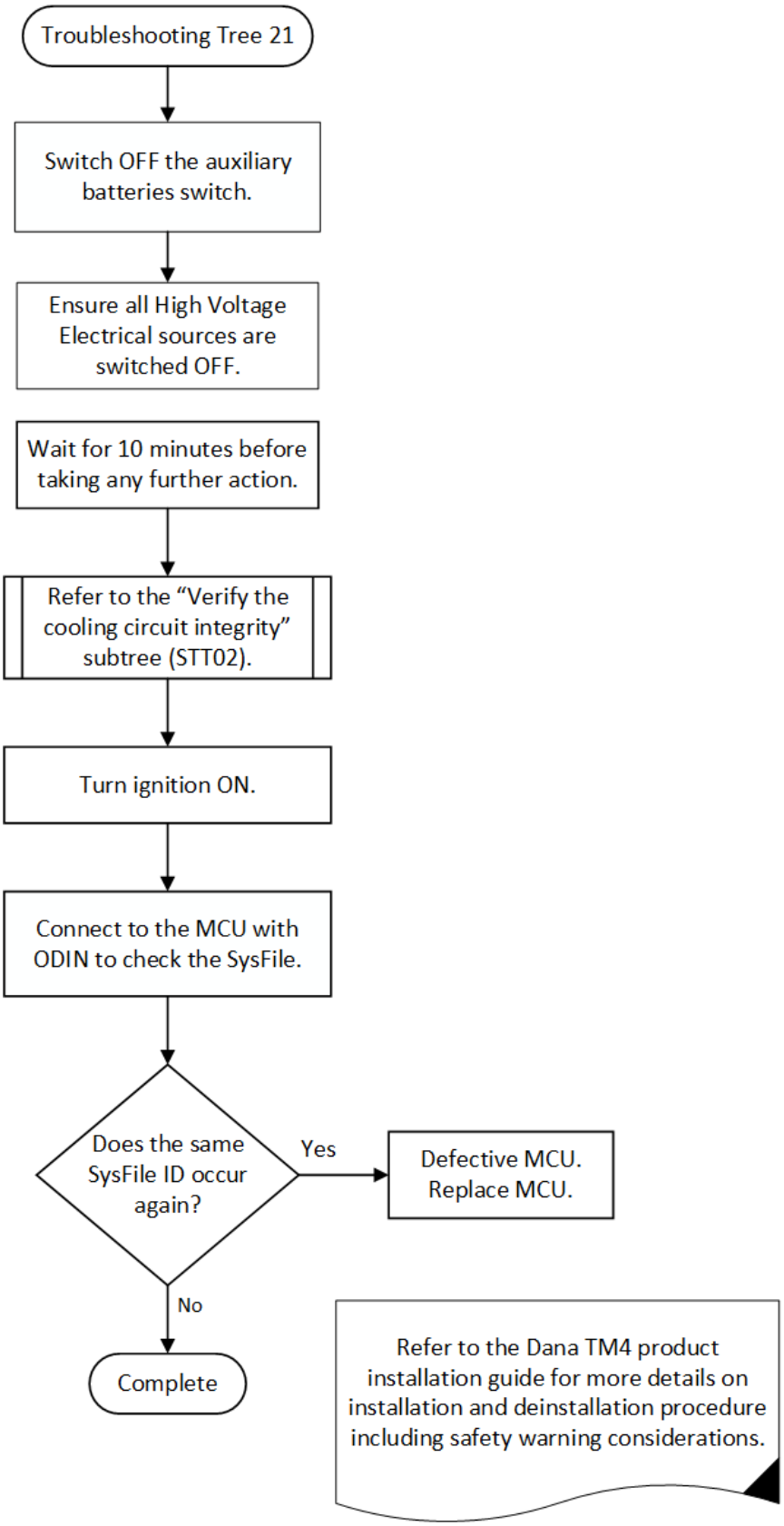
Note: The flow of the cooling liquid is too low to cool the motor. Refer to the cooling system troubleshooting Guide.

Note: The temperature of the liquid temperature is too high to cool the motor. The system must be turned off and the coolant mixture must be replaced.

Note: The mixture of the cooling liquid was done badly, which does not let the coolant cool the motor. Replace the mixture of cooling liquid. Refer to the cooling system Service Manual.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 21
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Refer to the "Verify the cooling circuit integrity" subtree (STT02).
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
No
Complete
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT22: EMI Temperature measurement over limit

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x3112	The internal EMI section temperature measurement went over the limit and caused the system to go in a fault state.	**1.** Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high. **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit). **5.** Wrong torque applied to one or both DC lugs. **6.** Wrong DC cable crimping. **7.** Defective MCU.

Description

The Troubleshooting Tree 22 indicates an error where an internal temperature sensor had a reading which was greater than the limit, and causes MCU defective state.

Listed below are the possible artifacts of this SysFile ID, in order of likelihood:

1. The loss of the cooling circuit integrity. Refer to the Sub Troubleshooting Tree STT02 Verify Coolant integrity of the motor and MCU cooling circuit.
2. There are signs of burnt spots on the MCU contacts and on the phase cables. Or, the wrong torque was used on one or more of the phase lugs, and / or, the wrong phase cable crimping on one or more of the phase lugs.
3. Connect TM4 ODIN to check if these SysFile IDs occur again. If this is the case, the MCU is defective. Turn Ignition OFF and all high voltage electrical sources before replacing MCU.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: There is air in the cooling circuit. The air must be let out of the cooling circuit.

Note: The flow of the cooling liquid is too low to cool the motor. Refer to the cooling system troubleshooting Guide.

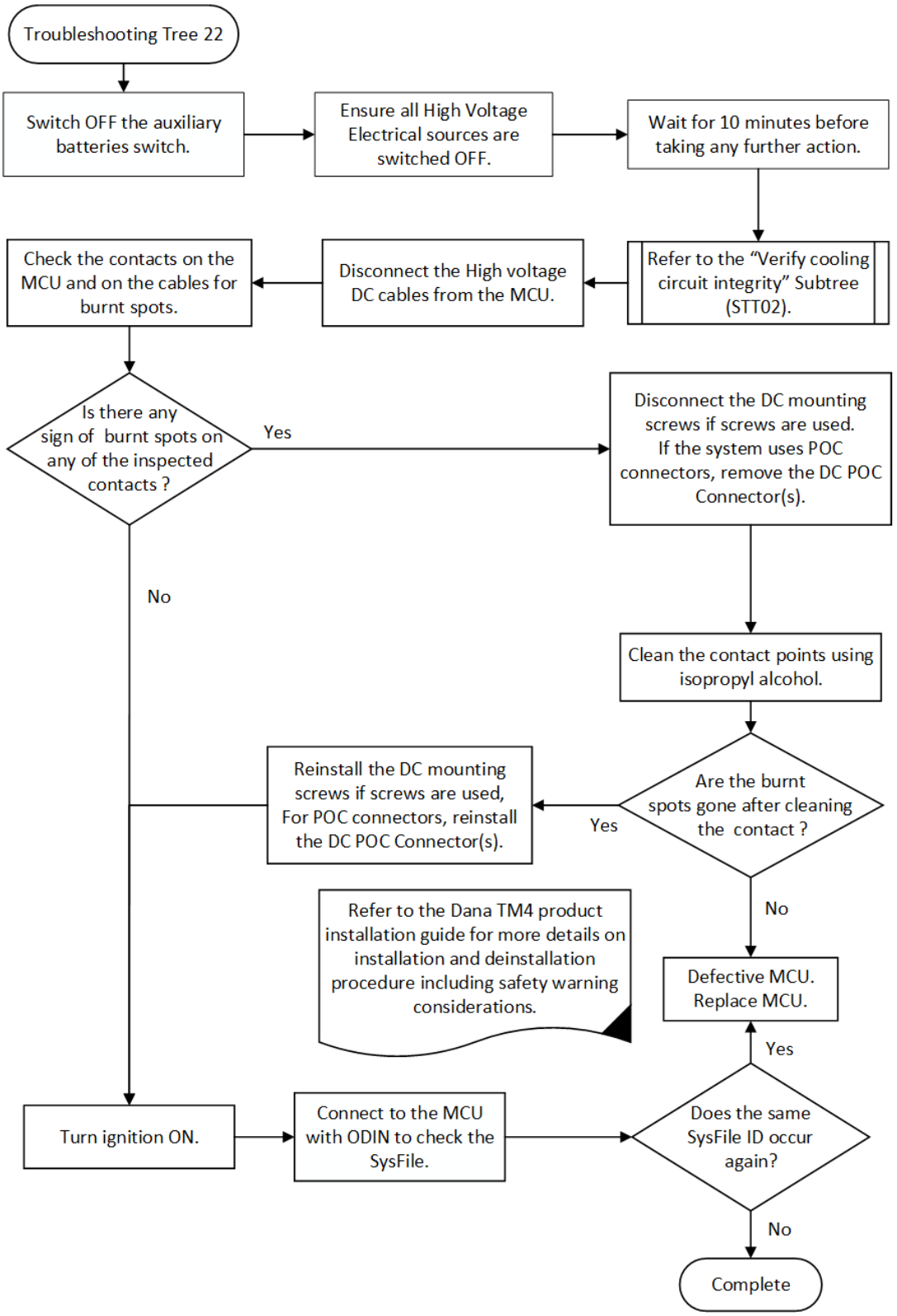
Note: The temperature of the liquid temperature is too high to cool the motor. The system must turn Ignition off and the coolant mixture must be replaced. Refer to the cooling system Service Manual.

Note: The mixture of the cooling liquid was done badly, which does not let the coolant cool the motor. Replace the mixture of cooling liquid. Refer to the cooling system Service Manual.

Note: The wrong phase cable crimping on one or more of the phase lugs. Replace the cable.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 22
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Refer to the "Verify cooling circuit integrity" Subtree (STT02).
Disconnect the High voltage DC cables from the MCU.
Check the contacts on the MCU and on the cables for burnt spots.
Is there any sign of burnt spots on any of the inspected contacts ?
Yes
No
Disconnect the DC mounting screws if screws are used. If the system uses POC connectors, remove the DC POC Connector(s).
Clean the contact points using isopropyl alcohol.
Are the burnt spots gone after cleaning the contact ?
Yes
Reinstall the DC mounting screws if screws are used, For POC connectors, reinstall the DC POC Connector(s).
No
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Defective MCU. Replace MCU.
Yes
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
No
Complete

TT23: Motor Coil Temperature Sensor measurement over limit

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x320F	One of the temperature sensors of the motor coil went over the limit and caused the system to go in a failure state.	**1.** Another SysFile occurred (TT05) **2.** Air in the cooling circuit. **3.** Cooling liquid flow too low or nil (cooling pump issue). **4.** Cooling liquid temperature too high **5.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit). **6.** Active short circuit mechanism activated (for more than 2 minutes without speed reduction under safe back EMF voltage). **7.** Defective motor.

Description

The Troubleshooting Tree 23 indicates an error where one of the temperature sensors of the motor coil had a reading where the temperature was greater than the maximum limit and causes MCU defective state.

Listed below are the possible artifacts of this SysFile ID, in order of likelihood:

1. The SysFile IDs occur in the same time as 0x320F, refer to the TT05.
2. The loss of the cooling circuit integrity. Refer to the Sub Troubleshooting Tree STT02 Verify Coolant integrity of the motor and MCU cooling circuit.
3. The motor is hot. The short circuit protection was turned on for more than 2 minutes. Wait the motor cooling down.
4. When the motor is cooled down, turn Ignition on. Connect TM4 ODIN to check if this SysFile ID occurs again. If this is the case, the MCU is defective. Turn Ignition OFF and all high voltage electrical sources before replacing MCU.

Note: Refer to the motor installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: Refer to the Application Note High-speed fault management document.

Note: There is air in the cooling circuit. The air must be let out of the cooling circuit.

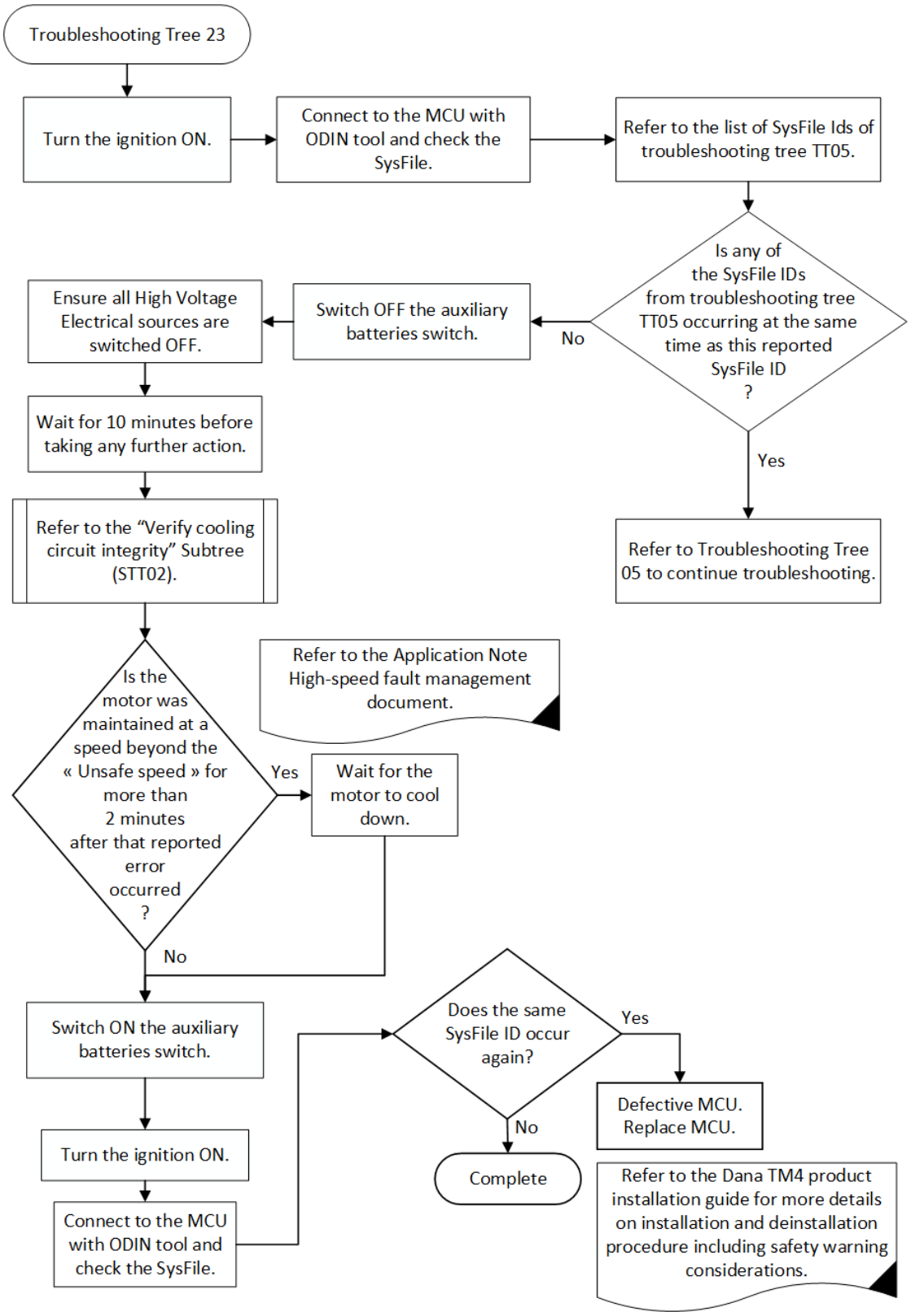
Note: The flow of the cooling liquid is too low to cool the motor. Refer to the cooling system troubleshooting Guide.

Note: The temperature of the liquid temperature is too high to cool the motor. The system must turn Ignition off and the coolant mixture must be replaced. Refer to the cooling system Service Manual.

Note: The mixture of the cooling liquid was done badly, which does not let the coolant cool the motor. Replace the mixture of cooling liquid. Refer to the cooling system Service Manual.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 23
Turn the ignition ON.
Connect to the MCU with ODIN tool and check the SysFile.
Refer to the list of SysFile Ids of troubleshooting tree TT05.
Is any of the SysFile IDs from troubleshooting tree TT05 occurring at the same time as this reported SysFile ID ?
No
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Refer to the "Verify cooling circuit integrity" Subtree (STT02).
Yes
Refer to Troubleshooting Tree 05 to continue troubleshooting.
Is the motor was maintained at a speed beyond the « Unsafe speed » for more than 2 minutes after that reported error occurred ?
Refer to the Application Note High-speed fault management document.
Yes
Wait for the motor to cool down.
No
Switch ON the auxiliary batteries switch.
Turn the ignition ON.
Connect to the MCU with ODIN tool and check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
No
Complete

TT24: High Resolver Temperature

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x3405	The Resolver Converter Chip detected a resolver chip high temperature.	**1.** Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high. **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit. **5.** Defective MCU.

Description

The Troubleshooting Tree 24 indicates an error where the resolver converter chip detected high temperature for the resolver chip.

The Motor and MCU cooling circuit is a possible cause of this SysFile ID. If this is the case, refer to the Sub Troubleshooting Tree STT02 to verify the cooling circuit integrity of the motor and MCU cooling circuit.

The MCU itself may also be defective.

Note: Refer to the motor installation guide for more details on installation and deinstallation procedure including safety warning considerations.

Note: There is air in the cooling circuit. The air must be let out of the cooling circuit.

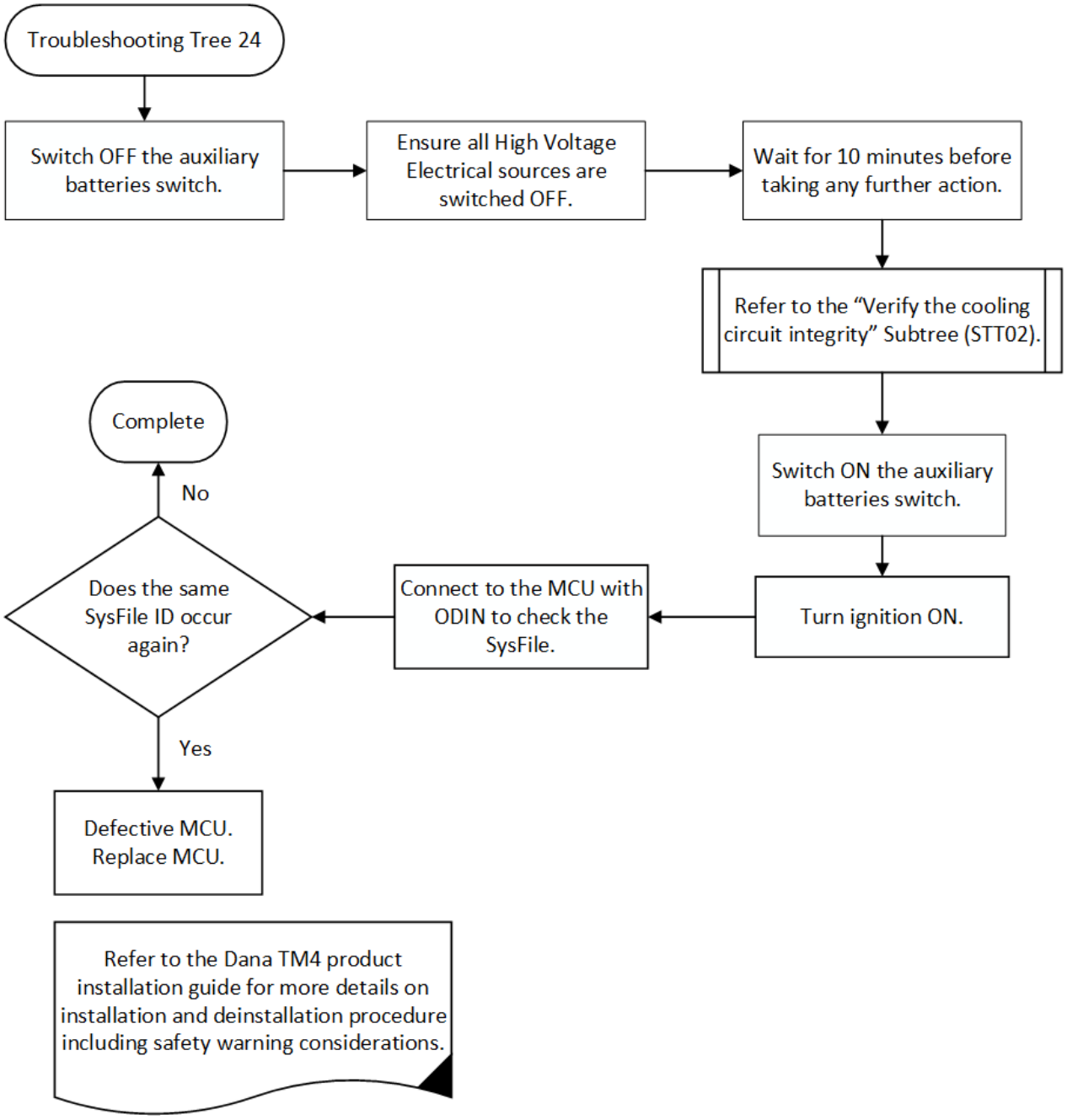
Note: The flow of the cooling liquid is too low to cool the motor. Refer to the cooling system troubleshooting Guide.

Note: The temperature of the liquid temperature is too high to cool the motor. The system must turn Ignition off and the coolant mixture must be replaced. Refer to the cooling system Service Manual.

Note: The mixture of the cooling liquid was done badly, which does not let the coolant cool the motor. Replace the mixture of cooling liquid. Refer to the cooling system Service Manual.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics


Troubleshooting Tree 24
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Refer to the "Verify the cooling circuit integrity" Subtree (STT02).
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT25: Internal Software Command Not Received Properly

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x3111 0x4000	An internal software command mechanism was not received properly.	**1.** Software problem. Update inverter software. **2.** Defective MCU

Description

The Troubleshooting Tree 25 indicates an error where a software command was not received correctly in the MCU.

These SysFile IDs is a software version issue. The user must update the software of the MCU to the last version published in Dana TM4 extranet.
The MCU itself may also be defective.

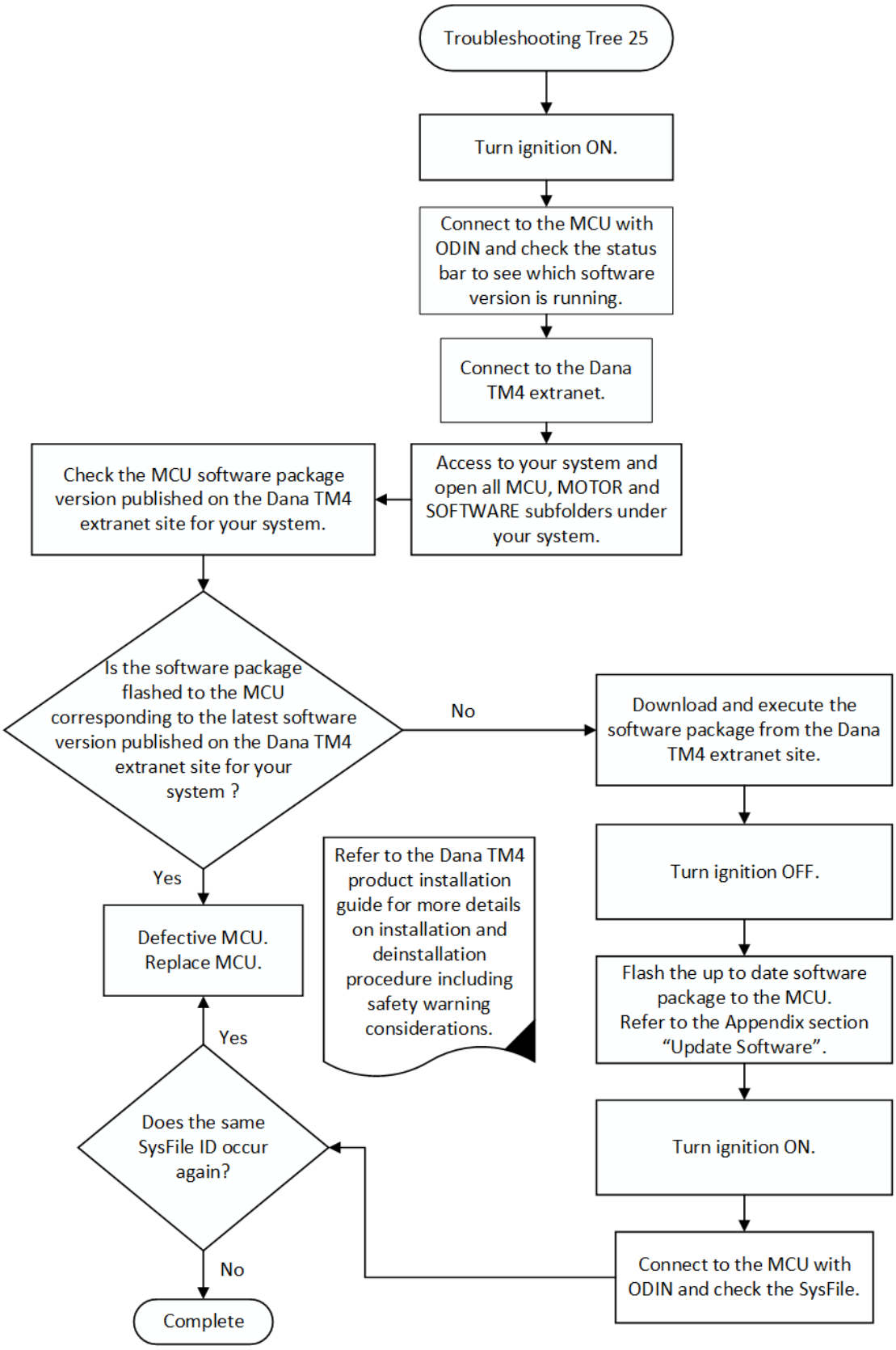
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Related Process

The TT25 call the following process:

- Appendix 6: Update Software


Troubleshooting Tree 25
Turn ignition ON.
Connect to the MCU with ODIN and check the status bar to see which software version is running.
Connect to the Dana TM4 extranet.
Access to your system and open all MCU, MOTOR and SOFTWARE subfolders under your system.
Check the MCU software package version published on the Dana TM4 extranet site for your system.
Is the software package flashed to the MCU corresponding to the latest software version published on the Dana TM4 extranet site for your system ?
No
Download and execute the software package from the Dana TM4 extranet site.
Turn ignition OFF.
Flash the up to date software package to the MCU. Refer to the Appendix section "Update Software".
Turn ignition ON.
Connect to the MCU with ODIN and check the SysFile.
Does the same SysFile ID occur again?
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Yes
No
Complete

TT26: IGBT Short Circuit Activated

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x3113	The IGBT short circuit mechanism has been activated. This event is normally a reaction to another event.	**1.** Other error causes the system to move in defective while in high speed (back EMF too high to maintain DC bus under the high voltage limit).

Description

The Troubleshooting Tree 26 indicates an error where the IGBT short circuit mechanism was activated, in reaction to another event.

Other error caused the MCU defective while operating at a high speed, (back Electro-mechanical Feedback is too high to maintain DC bus under the high voltage limit).

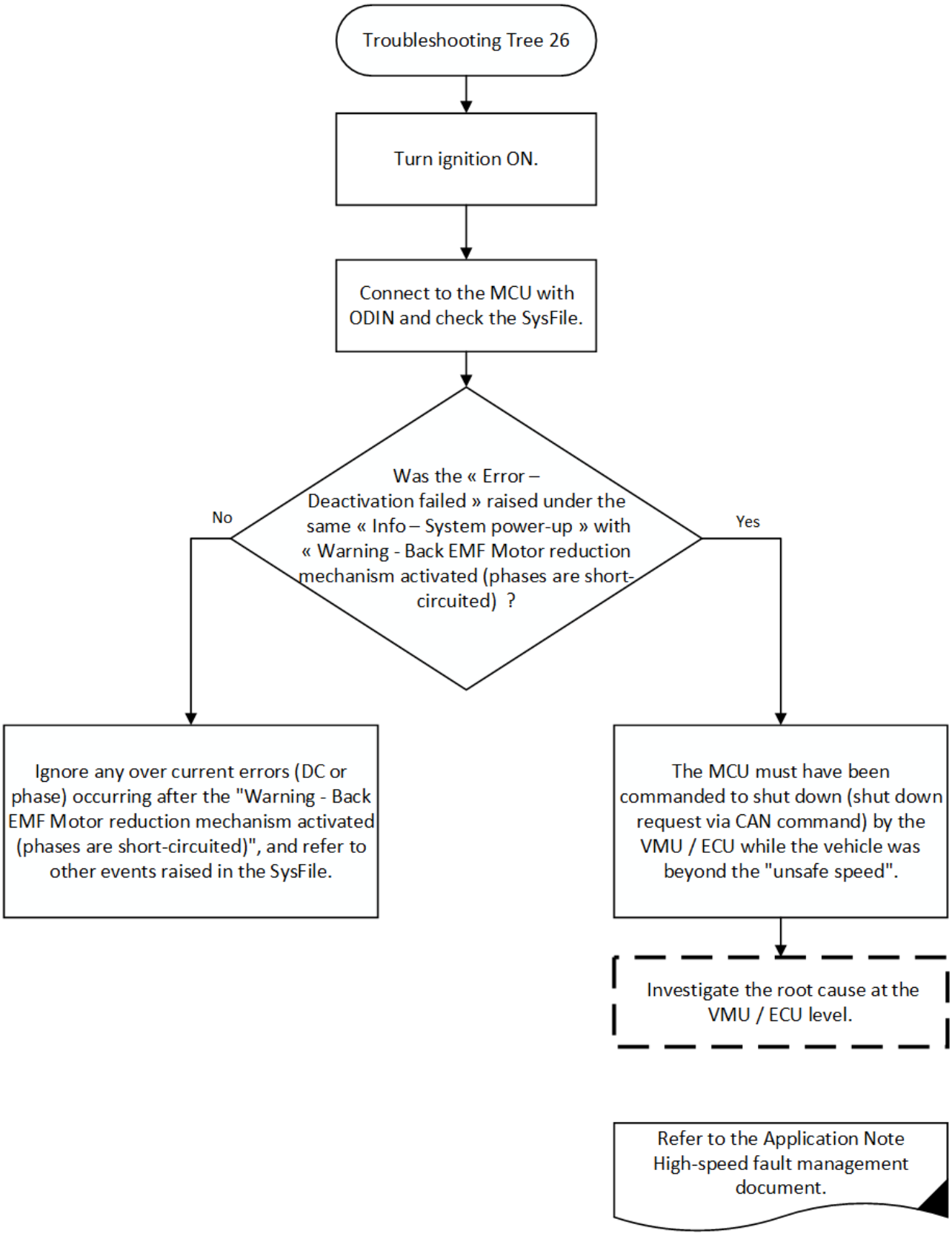
MCU must have been commanded to shut down by the VMU /ECU (via CAN bus) while the vehicle was beyond the “unsafe speed”. Refer the Troubleshooting Guide of the VMU /ECU for investigation of the causes.

Note: Back EMF Motor reduction mechanism
Any error event raised by the system while the motor speed is beyond the "unsafe speed" will activate the phase short circuit mechanism through the MCU power switch modules. This mechanism is activated to maintain the DC bus under the high voltage maximum limit until the motor speed is reduced under the « unsafe speed ».
At the time the motor phases are short circuited, it is normal that the phase currents and potentially the input DC current will temporarily exceed the limits and raise these errors type.
Other error(s) must be investigated.

Note: Refer to the Application note High-Speed fault Management Document.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 26
Turn ignition ON.
Connect to the MCU with ODIN and check the SysFile.
Was the « Error – Deactivation failed » raised under the same « Info – System power-up » with « Warning - Back EMF Motor reduction mechanism activated (phases are short-circuited) ?
No
Yes
Ignore any over current errors (DC or phase) occurring after the "Warning - Back EMF Motor reduction mechanism activated (phases are short-circuited)", and refer to other events raised in the SysFile.
The MCU must have been commanded to shut down (shut down request via CAN command) by the VMU / ECU while the vehicle was beyond the "unsafe speed".
Investigate the root cause at the VMU / ECU level.
Refer to the Application Note High-speed fault management document.

TT27: Phase Current reached Maximum

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x3200 0x3201 0x3202 0x3204 0x3205 0x3206 0x3208 0x3209 0x320A	One or more of the phase currents reached the maximum design threshold.	**1.** Short circuit between phases. **2.** The auxiliary vehicle battery not operating correctly. **3.** Intermittent or bad Vaux connection at the MCU. **4.** Vaux Fuse about to open or more resistive. **5.** An external error was caused by VMU/ECU. **6.** Defective MCU.

Description

The Troubleshooting Tree 27 indicates an error where the current in one or more of the phase cables were at the maximum design threshold.

This SysFile may be raised by Back EMF Motor reduction mechanism or warning of the Motor-Control Inverter 0x00 to 08 or by a connector issue.

The low Vaux may raise these SysFile IDs, refer to the Troubleshooting tree TT03.

An external error from VMU/ECU can be a cause. It must be investigated.

The MCU itself may be defective.

Note: If the auxiliary vehicle battery system is defective turn Ignition off and high voltage electrical sources, refer to the auxiliary vehicle battery Troubleshooting Guide.

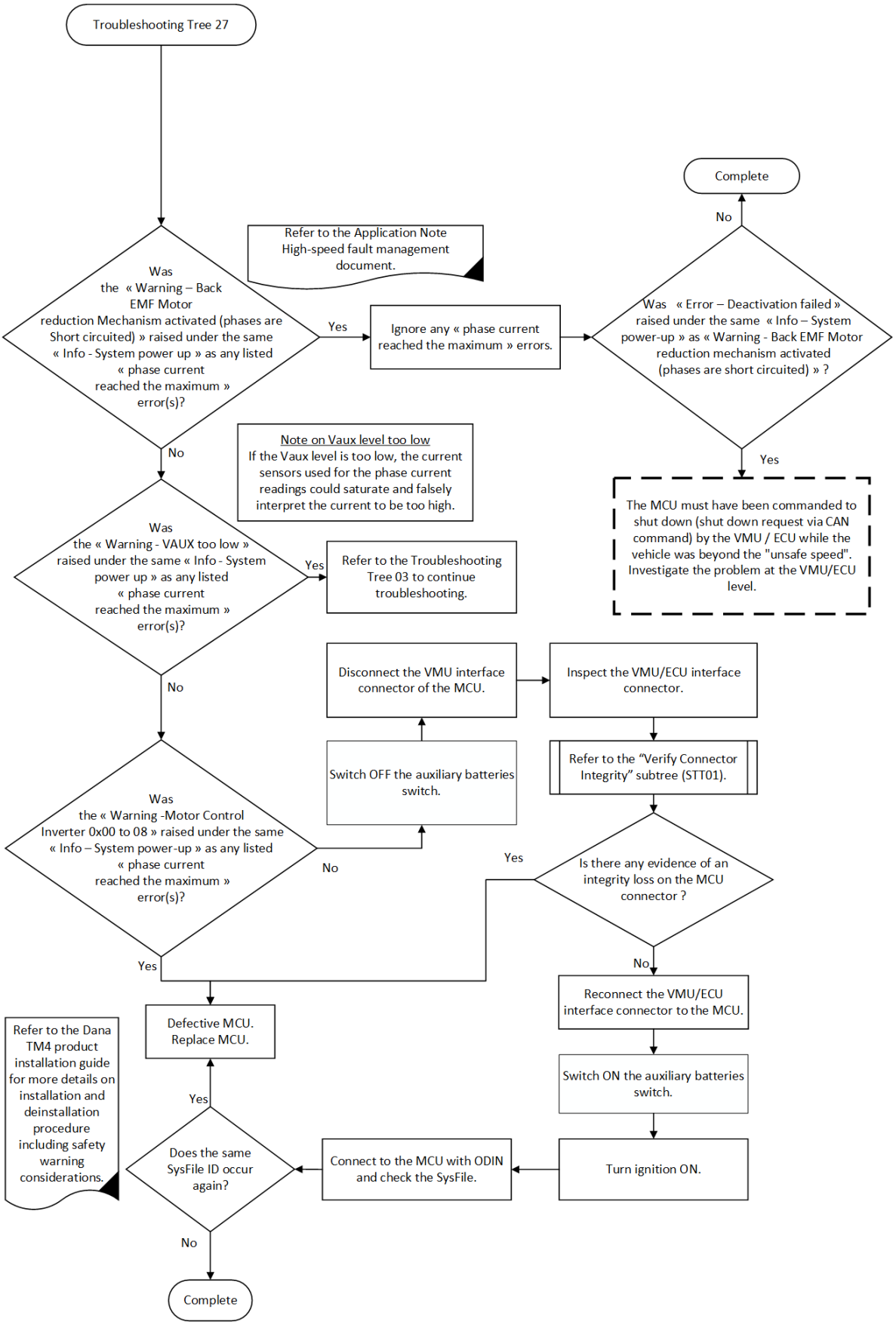
Note: The Vaux fuse connecting the auxiliary vehicle battery became more resistive, or about to open. In this case, turn Ignition OFF and all high voltage electrical sources, refer to the auxiliary vehicle battery or Low Voltage distribution board Troubleshooting Guide.

Note: Back EMF Motor reduction mechanism
If any error type is raised by the system while the motor speed is beyond the « unsafe speed », the motor phases will be short circuited by the control to maintain DC bus under the high voltage limit until the motor speed is reduced below the « unsafe speed ».
At the time the motor phases are short circuited, it is normal that the phase currents and potentially the input DC current will temporarily exceed the limits and raise these errors type.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 27
Was the « Warning – Back EMF Motor reduction Mechanism activated (phases are Short circuited) » raised under the same « Info - System power up » as any listed « phase current reached the maximum » error(s)?
Yes
Ignore any « phase current reached the maximum » errors.
Was « Error – Deactivation failed » raised under the same « Info – System power-up » as « Warning - Back EMF Motor reduction mechanism activated (phases are short circuited) » ?
No
Complete
Yes
The MCU must have been commanded to shut down (shut down request via CAN command) by the VMU / ECU while the vehicle was beyond the "unsafe speed". Investigate the problem at the VMU/ECU level.
Refer to the Application Note High-speed fault management document.
No
Note on Vaux level too low
If the Vaux level is too low, the current sensors used for the phase current readings could saturate and falsely interpret the current to be too high.
Was the « Warning - VAUX too low » raised under the same « Info - System power up » as any listed « phase current reached the maximum » error(s)?
Yes
Refer to the Troubleshooting Tree 03 to continue troubleshooting.
No
Was the « Warning -Motor Control Inverter 0x00 to 08 » raised under the same « Info – System power-up » as any listed « phase current reached the maximum » error(s)?
No
Switch OFF the auxiliary batteries switch.
Disconnect the VMU interface connector of the MCU.
Inspect the VMU/ECU interface connector.
Refer to the "Verify Connector Integrity" subtree (STT01).
Is there any evidence of an integrity loss on the MCU connector ?
Yes
No
Yes
Defective MCU. Replace MCU.
Reconnect the VMU/ECU interface connector to the MCU.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN and check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Complete

TT28: Phase Current Sum reached Maximum

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x3203 0x3207 0x320B	The phase 1-2-3, 4-5-6, or 7-8-9 current sum reached the maximum limit.	**1.** The auxiliary vehicle battery not operating correctly. **2.** Intermittent or bad Vaux connection at the MCU. **3.** Vaux Fuse about to open or more resistive. **4.** Defective MCU.

Description

The troubleshooting tree 28 indicates a warning where the sum of the phase currents of phases trios 1-2-3, 4-5-6, and/or 7-8-9 are equal to or higher than the maximum limit.

This SysFile may be raised by “Warning - Vaux too low” under the same « Info - System power up » as « phase current reached the maximum ».

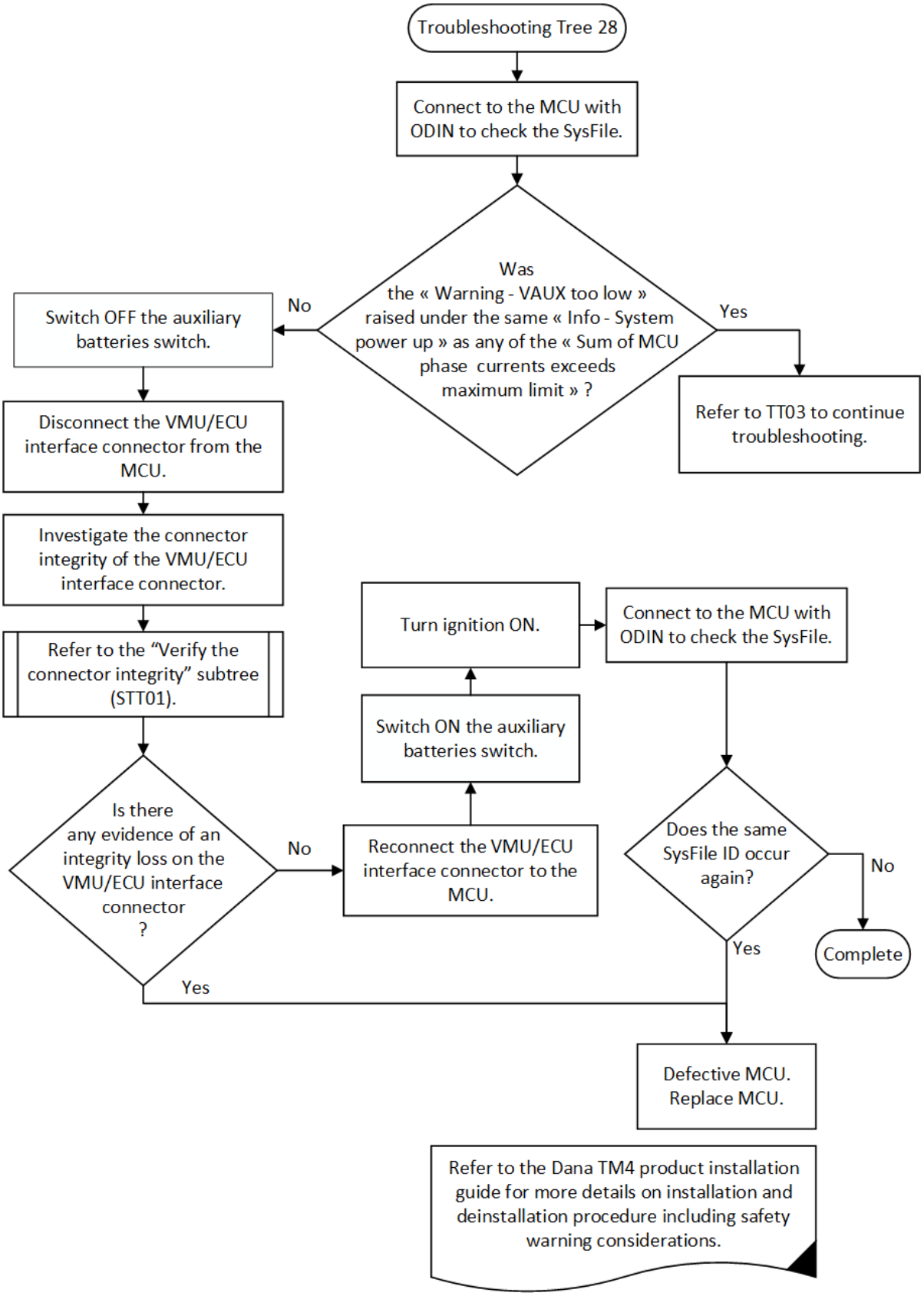
The MCU itself may be defective.

Note: Note on Vaux level too low.
If the Vaux level is too low, the current sensors used for the phase current readings could saturate and falsely interpret the current

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 28
Connect to the MCU with ODIN to check the SysFile.
Was the « Warning - VAUX too low » raised under the same « Info - System power up » as any of the « Sum of MCU phase currents exceeds maximum limit » ?
No
Yes
Refer to TT03 to continue troubleshooting.
Switch OFF the auxiliary batteries switch.
Disconnect the VMU/ECU interface connector from the MCU.
Investigate the connector integrity of the VMU/ECU interface connector.
Refer to the "Verify the connector integrity" subtree (STT01).
Is there any evidence of an integrity loss on the VMU/ECU interface connector ?
No
Yes
Reconnect the VMU/ECU interface connector to the MCU.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT29: Insufficient Defluxing Current at high speed

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x320C	There is not enough defluxing current at high speed.	**1.** MCU temperature too high for the motor speed (verify cooling). **2.** Motor temperature too high for the motor speed (verify cooling). **3.** Defective MCU. **4.** Defective motor.

Description

The Troubleshooting Tree 29 indicates an error where the defluxing current is not large enough when the motor speed is at high speed level.

The cooling circuit issue may raise this SysFile ID.

A road test discriminates defective Motor and defective MCU from cooling circuit issue.
Another road test discriminates the motor from the MCU defectives.

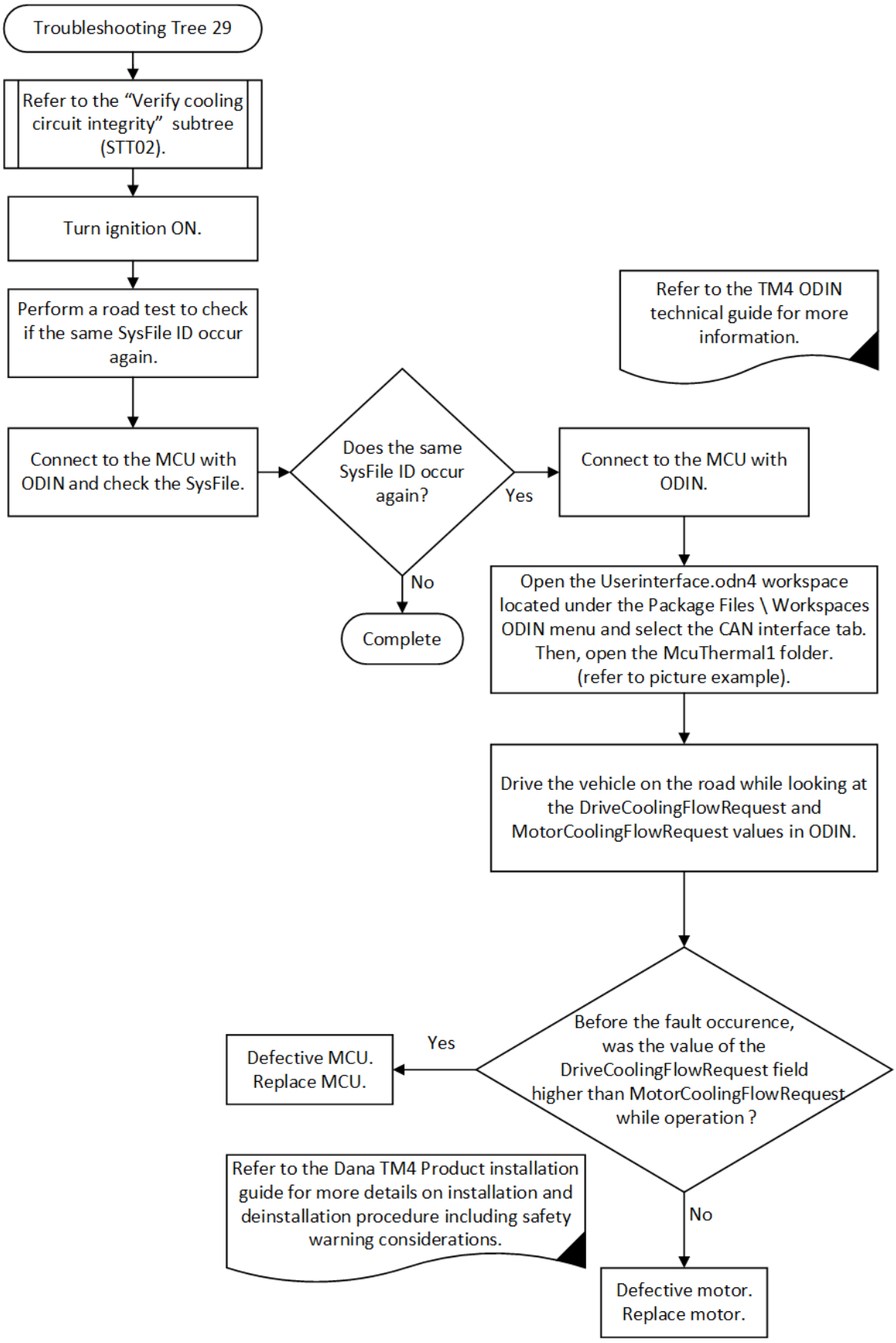
Note: on this error type
This error type indicates that there is not enough defluxing current at high speed. The point of over speed can dynamically be reduced due to overheat of the MCU or motor. If one of those components is overheating, there might be not enough defluxing current at high speed and this error will be raised.

Note: Refer to the TM4 ODIN technical guide for more information.

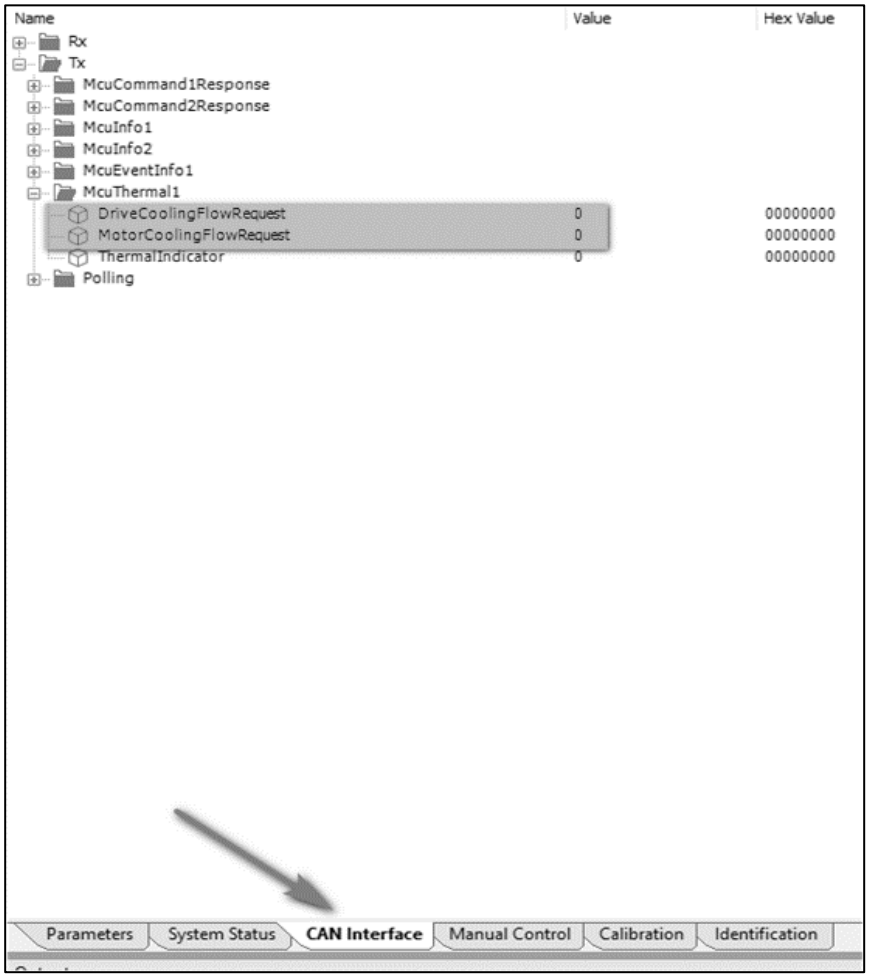
Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 29
Refer to the "Verify cooling circuit integrity" subtree (STT02).
Turn ignition ON.
Perform a road test to check if the same SysFile ID occur again.
Connect to the MCU with ODIN and check the SysFile.
Does the same SysFile ID occur again?
Yes
No
Complete
Refer to the TM4 ODIN technical guide for more information.
Connect to the MCU with ODIN.
Open the Userinterface.odn4 workspace located under the Package Files \ Workspaces ODIN menu and select the CAN interface tab. Then, open the McuThermal1 folder. (refer to picture example).
Drive the vehicle on the road while looking at the DriveCoolingFlowRequest and MotorCoolingFlowRequest values in ODIN.
Before the fault occurence, was the value of the DriveCoolingFlowRequest field higher than MotorCoolingFlowRequest while operation ?
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
No
Defective motor. Replace motor.

References


Name
Value
Hex Value
Rx
Tx
McuCommand1Response
McuCommand2Response
McuInfo1
McuInfo2
McuEventInfo1
McuThermal1
DriveCoolingFlowRequest
0
00000000
MotorCoolingFlowRequest
0
00000000
ThermalIndicator
0
00000000
Polling
Parameters
System Status
CAN Interface
Manual Control
Calibration
Identification

TT30: AC current – Torque Mismatch

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x320D	The reference torque is not matching with the estimated torque (most of the time lower than reference).	**1.** Phase cable lugs not properly assembled on inverter or motor. **2.** Wrong phase cables order. **3.** Motor resolver signal incoherence (intermittence signal, distorted signal). **4.** Defective MCU.

Description

The Troubleshooting Tree 30 indicates an error where the level of torque to the motor doesn't match the amount of power delivered by the AC current.

The Connections between the motor and the MCU, and the damaged phase cables or motor sensor cables defectives may cause the SysFile ID.
The incorrect connection configuration (Standard or Reverse) of the phase cables may cause the issue.
The loss of sensor connector integrity may cause the SysFile ID.

All the phase cables and their connection on the MCU and the motor are needed to be fully functional and complying to the installation manual.

TM4 ODIN diagnostic tool allows to visualize the motor resolver angle waveform: see next page.

The MCU itself may be defective.

Note: Refer to the TM4 Product installation guide and operation and maintenance manual for more details on the phase cables configurations and parameter setting.

Note: Refer to the motor installation guide for more details on installation and deinstallation procedure including safety warning considerations.

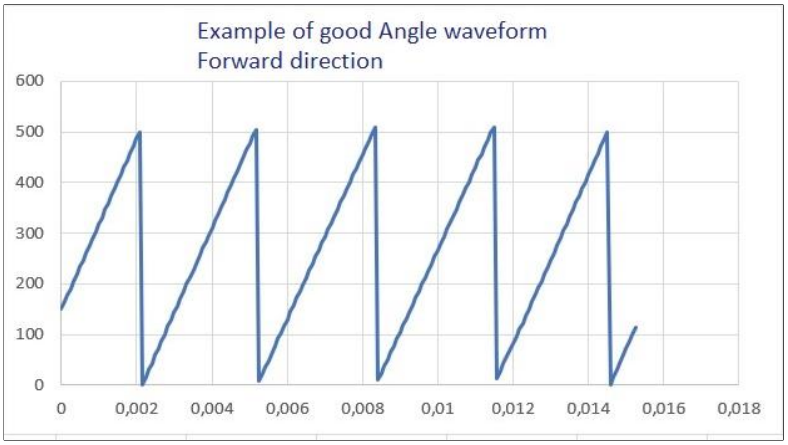
Note: Refer to the Dana TM4 product(s) MCU installation guide(s) for more details on installation and deinstallation procedure including safety warning considerations.

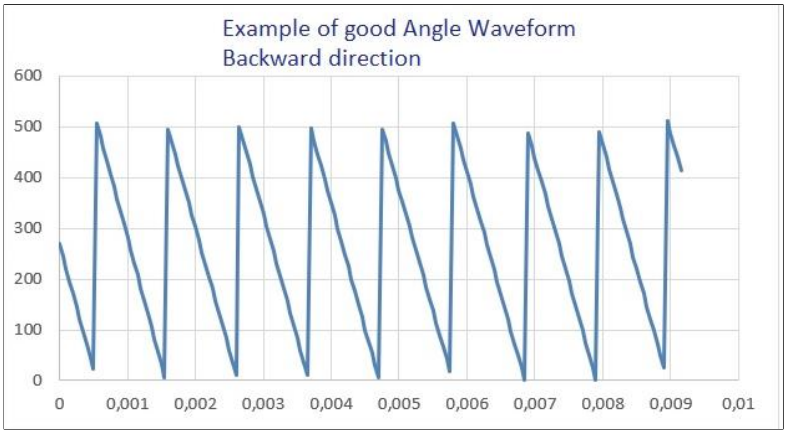
Note: If the MCU goes in failure, it will capture a BlackBox upon the high voltage battery reached the high limit error. The BlackBox can then be consulted via ODIN tool to see if the angle waveform (saw tooth) is straight on each rise and fall edges.

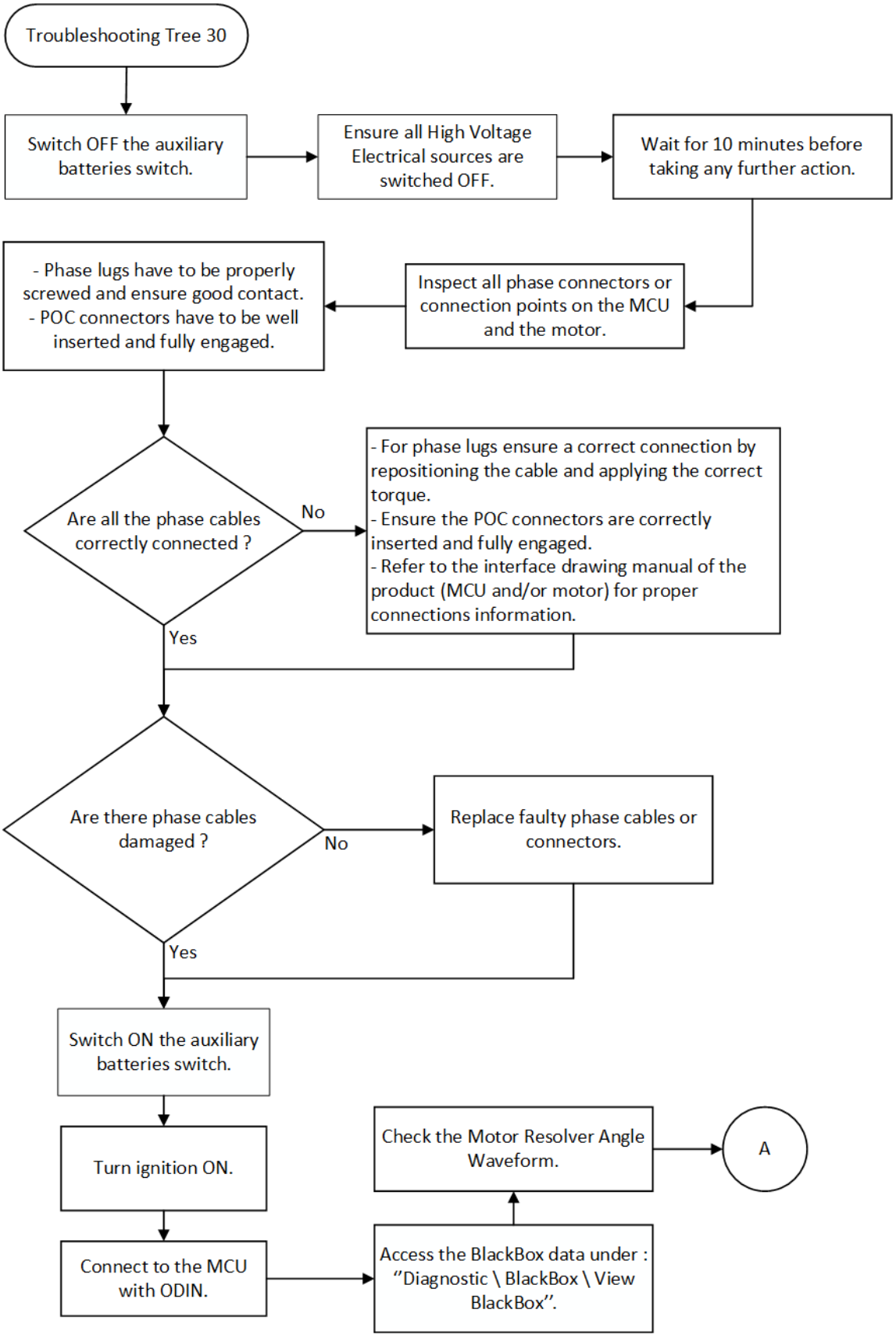
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

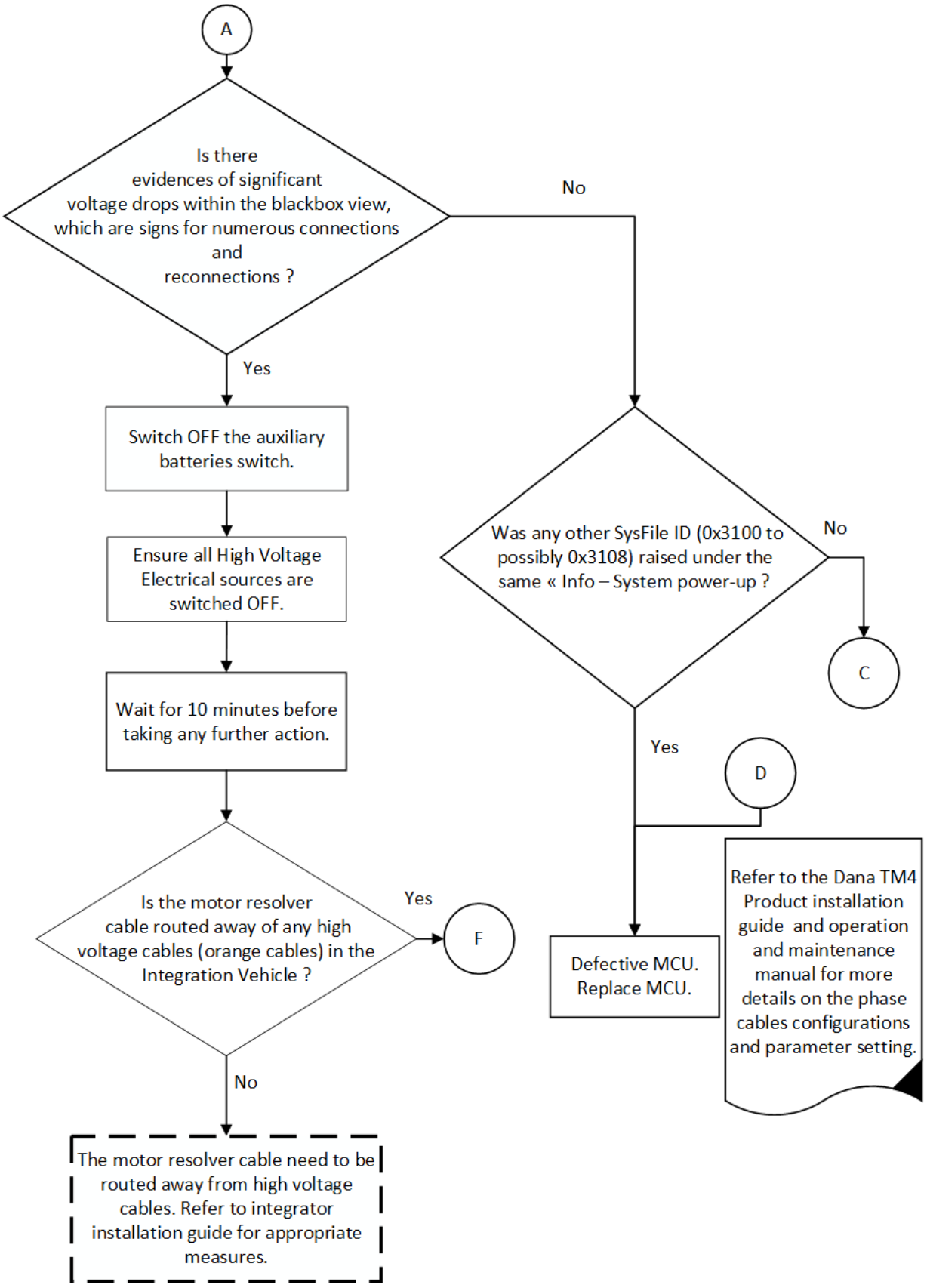
See "Safety Warnings" and "Troubleshooting Tips" sections for general guidelines on system diagnostics.

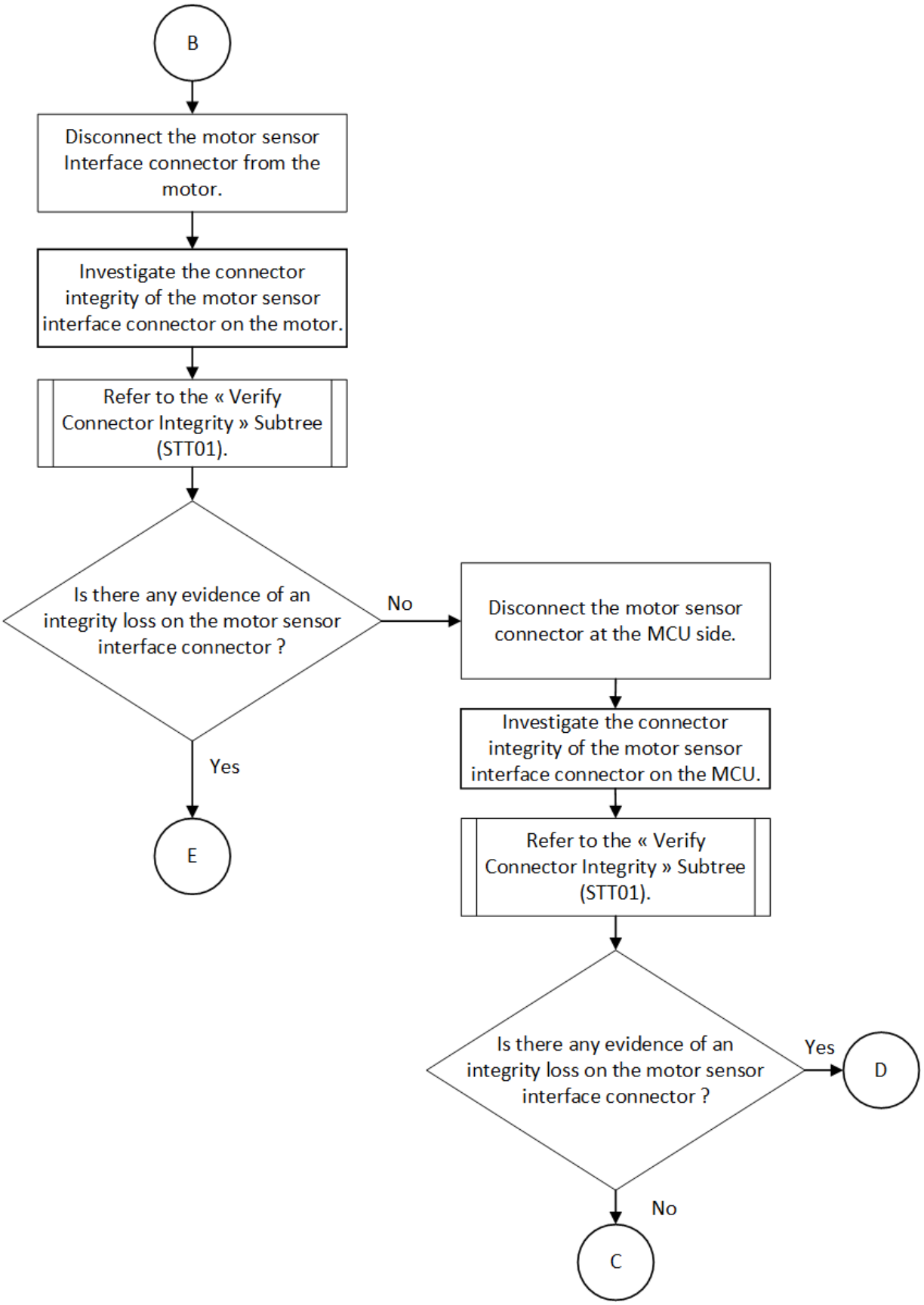
Note: Regarding the resolver angle waveform, if the MCU goes in faulty state, it will capture a BlackBox upon the reported error(s).
The BlackBox can then be consulted via ODIN tool to see if the angle waveform (saw tooth) is straight on each rising and falling edges.
See below examples of waveform.

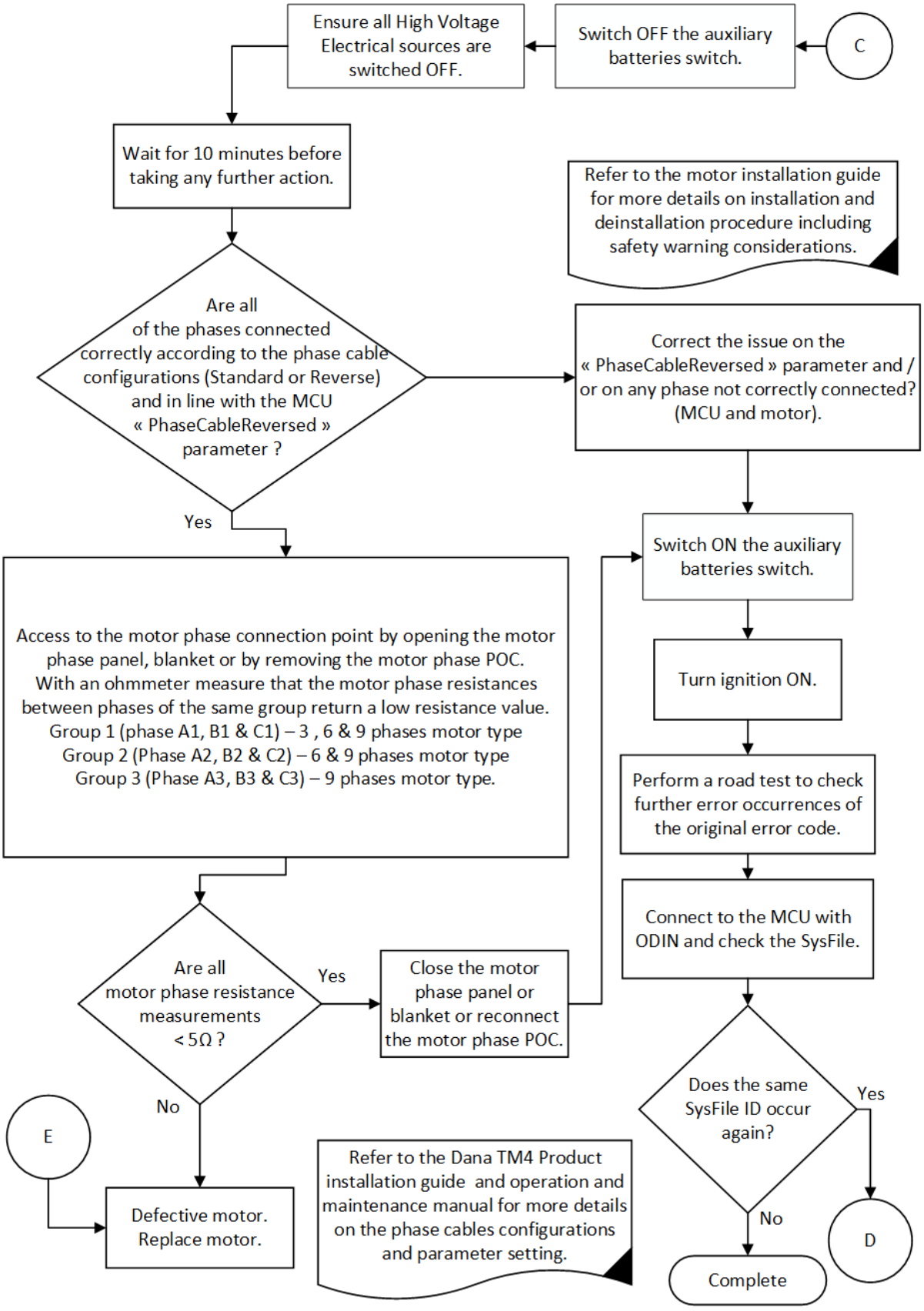


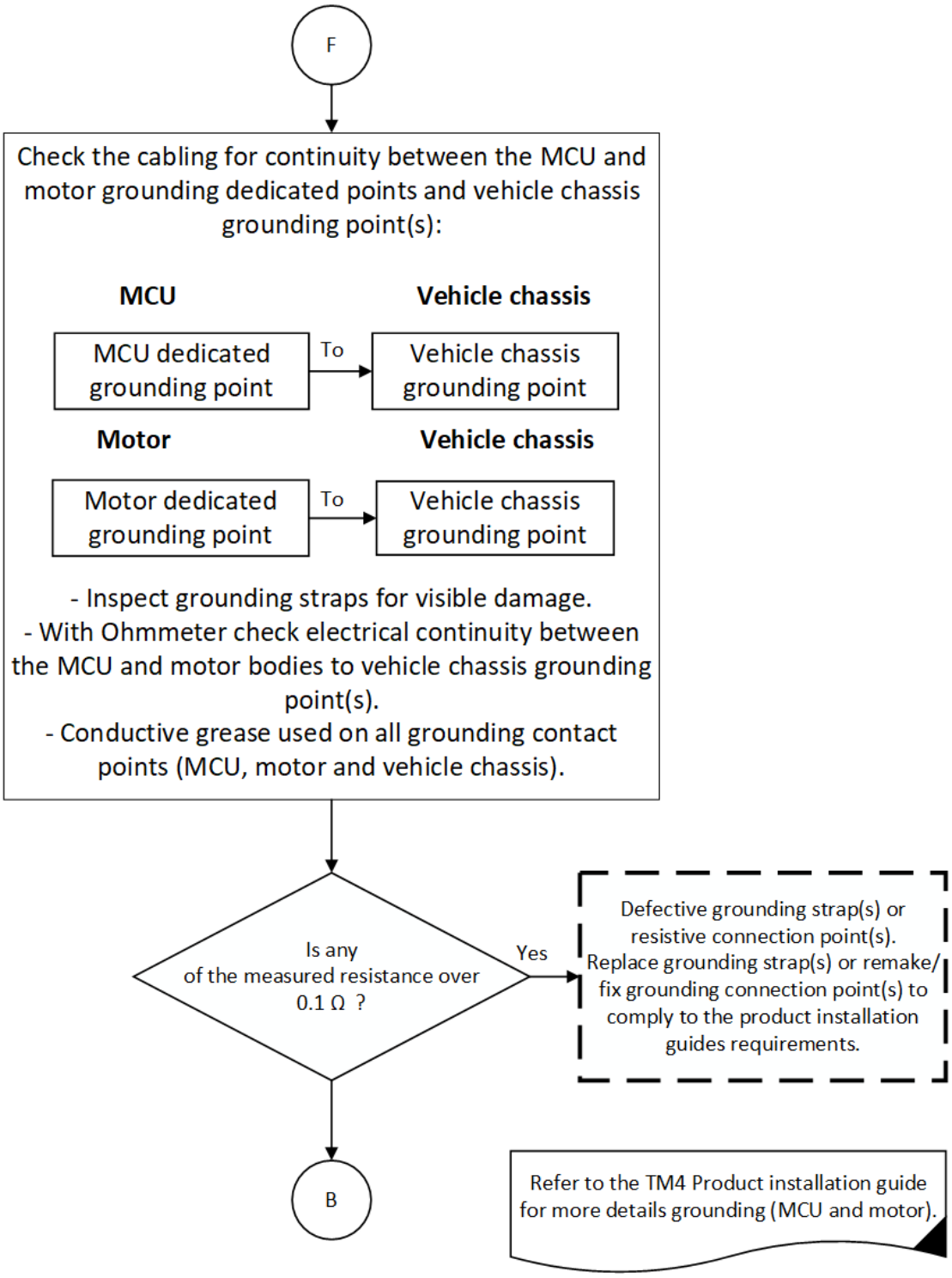



Troubleshooting Tree 30
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Inspect all phase connectors or connection points on the MCU and the motor.
- Phase lugs have to be properly screwed and ensure good contact.
- POC connectors have to be well inserted and fully engaged.
Are all the phase cables correctly connected ?
No
- For phase lugs ensure a correct connection by repositioning the cable and applying the correct torque.
- Ensure the POC connectors are correctly inserted and fully engaged.
- Refer to the interface drawing manual of the product (MCU and/or motor) for proper connections information.
Yes
Are there phase cables damaged ?
No
Replace faulty phase cables or connectors.
Yes
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN.
Access the BlackBox data under : "Diagnostic \ BlackBox \ View BlackBox".
Check the Motor Resolver Angle Waveform.
A


A
Is there evidences of significant voltage drops within the blackbox view, which are signs for numerous connections and reconnections ?
No
Yes
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Is the motor resolver cable routed away of any high voltage cables (orange cables) in the Integration Vehicle ?
Yes
F
No
The motor resolver cable need to be routed away from high voltage cables. Refer to integrator installation guide for appropriate measures.
Was any other SysFile ID (0x3100 to possibly 0x3108) raised under the same « Info – System power-up ?
No
C
Yes
D
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guide and operation and maintenance manual for more details on the phase cables configurations and parameter setting.


B
Disconnect the motor sensor Interface connector from the motor.
Investigate the connector integrity of the motor sensor interface connector on the motor.
Refer to the « Verify Connector Integrity » Subtree (STT01).
Is there any evidence of an integrity loss on the motor sensor interface connector ?
No
Yes
E
Disconnect the motor sensor connector at the MCU side.
Investigate the connector integrity of the motor sensor interface connector on the MCU.
Refer to the « Verify Connector Integrity » Subtree (STT01).
Is there any evidence of an integrity loss on the motor sensor interface connector ?
Yes
D
No
C


C
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Refer to the motor installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Are all of the phases connected correctly according to the phase cable configurations (Standard or Reverse) and in line with the MCU « PhaseCableReversed » parameter ?
Correct the issue on the « PhaseCableReversed » parameter and / or on any phase not correctly connected? (MCU and motor).
Yes
Switch ON the auxiliary batteries switch.
Access to the motor phase connection point by opening the motor phase panel, blanket or by removing the motor phase POC.
With an ohmmeter measure that the motor phase resistances between phases of the same group return a low resistance value.
Group 1 (phase A1, B1 & C1) – 3 , 6 & 9 phases motor type
Group 2 (Phase A2, B2 & C2) – 6 & 9 phases motor type
Group 3 (Phase A3, B3 & C3) – 9 phases motor type.
Turn ignition ON.
Perform a road test to check further error occurrences of the original error code.
Connect to the MCU with ODIN and check the SysFile.
Are all motor phase resistance measurements < 5Ω ?
Yes
Close the motor phase panel or blanket or reconnect the motor phase POC.
Does the same SysFile ID occur again?
Yes
No
E
No
Defective motor. Replace motor.
Refer to the Dana TM4 Product installation guide and operation and maintenance manual for more details on the phase cables configurations and parameter setting.
D
Complete


F
Check the cabling for continuity between the MCU and motor grounding dedicated points and vehicle chassis grounding point(s):
MCU
Vehicle chassis
MCU dedicated grounding point
To
Vehicle chassis grounding point
Motor
Vehicle chassis
Motor dedicated grounding point
To
Vehicle chassis grounding point
- Inspect grounding straps for visible damage.
- With Ohmmeter check electrical continuity between the MCU and motor bodies to vehicle chassis grounding point(s).
- Conductive grease used on all grounding contact points (MCU, motor and vehicle chassis).
Is any of the measured resistance over 0.1 Ω ?
Yes
Defective grounding strap(s) or resistive connection point(s). Replace grounding strap(s) or remake/ fix grounding connection point(s) to comply to the product installation guides requirements.
B
Refer to the TM4 Product installation guide for more details grounding (MCU and motor).

TT31: Phase Cable(s) Shorted to Chassis

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x320E	The system detected an insulation issue in-between the AC and the chassis or between the DC and chassis.	**1.** Another system on the same DC bus had a sudden loss of insulation **2.** Outdate software. **3.** Damaged phase cables. **4.** Defective connector causing the short circuit. **5.** Defective MCU. **6.** Defective motor.

Description

The Troubleshooting Tree 31 indicates an error where the cables (AC or DC) connecting the Motor and the MCU were shorted to the chassis, possibly due to a cable insulation problem.

Other systems on the same DC bus that reports a loss of insulation that could affect the MCU.

A MCU software upgrade might be more filtering concerning the detection of short circuits.

A damaged phase cable might be causing the error to be raised.
A sudden loss of insulation for system connected to the high voltage DC bus may occur.

The DC and phase connectors integrity loss or foreign material inside the connections might be causing the short circuits.

The MCU and/or the motor themselves may be defective.

Note: on the phase to chassis detection
The input DC voltage is electrically insulated from the chassis. A fast transient towards the chassis voltage level caused by another equipment can potentially trig the fault. Software upgrade might solve the issue providing more filtering to the detection.

Note: on the phase to chassis detection
A fast transient of more than 100 V / 10µs caused by another equipment can potentially trigger the fault. Software upgrade might solve the issue providing more filtering to the detection.

Note: Refer to the Dana TM4 Product installation guides for more details on installation and deinstallation procedure including safety warning considerations.

Note: Refer to the TM4 Product Interface drawing for more details on torque requirement

Note: on the phase cables
Ensure that the manufacturer of the cable is one of the recommended cables:

- SD-10402-16 Marking EVRP-150 1AWG from OMG,
- EXRAD XLE 155/XLE 1 AWG Shielded Cable from Champlain,
- 150 HVFX-XLE from Champlain.

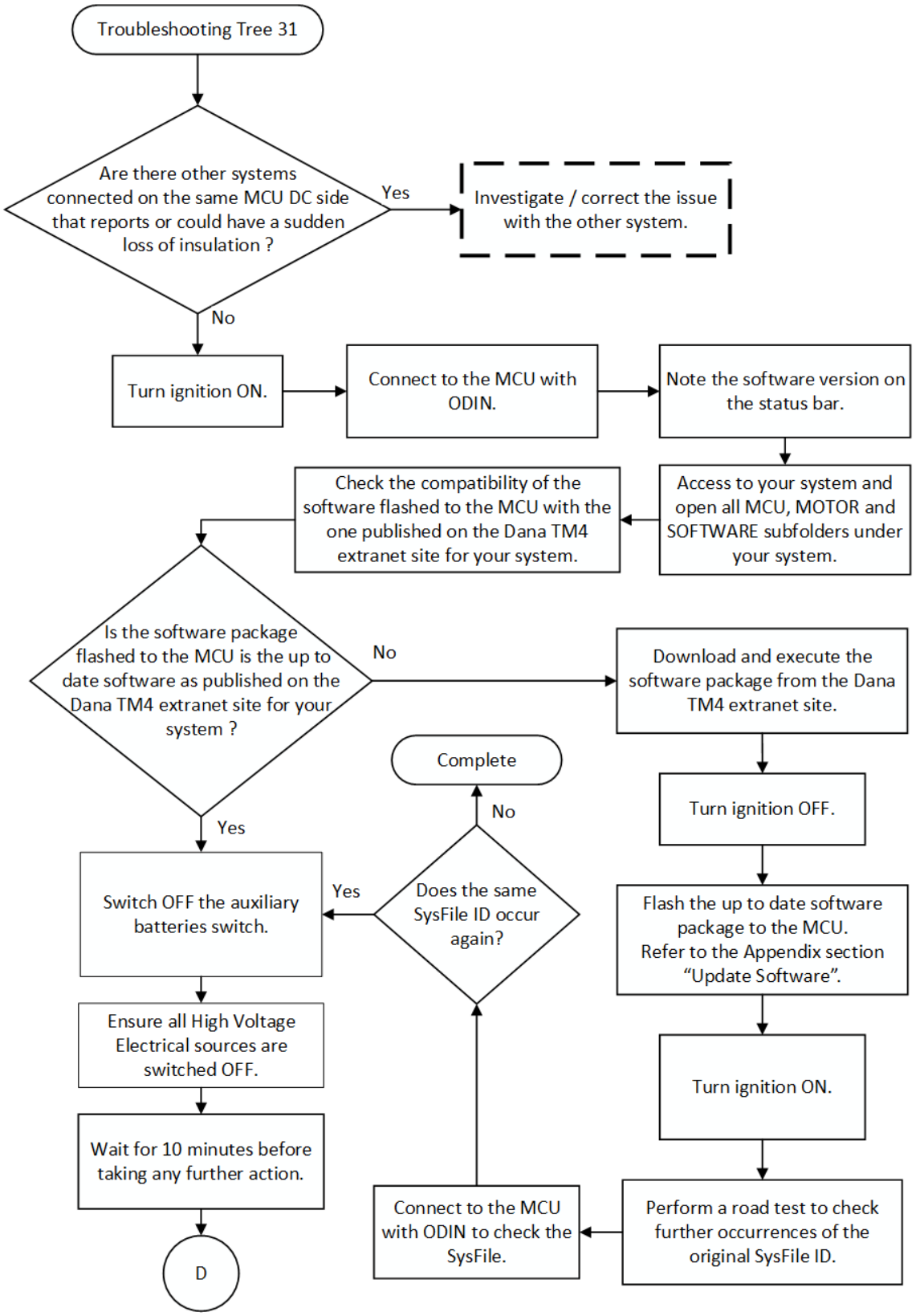
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

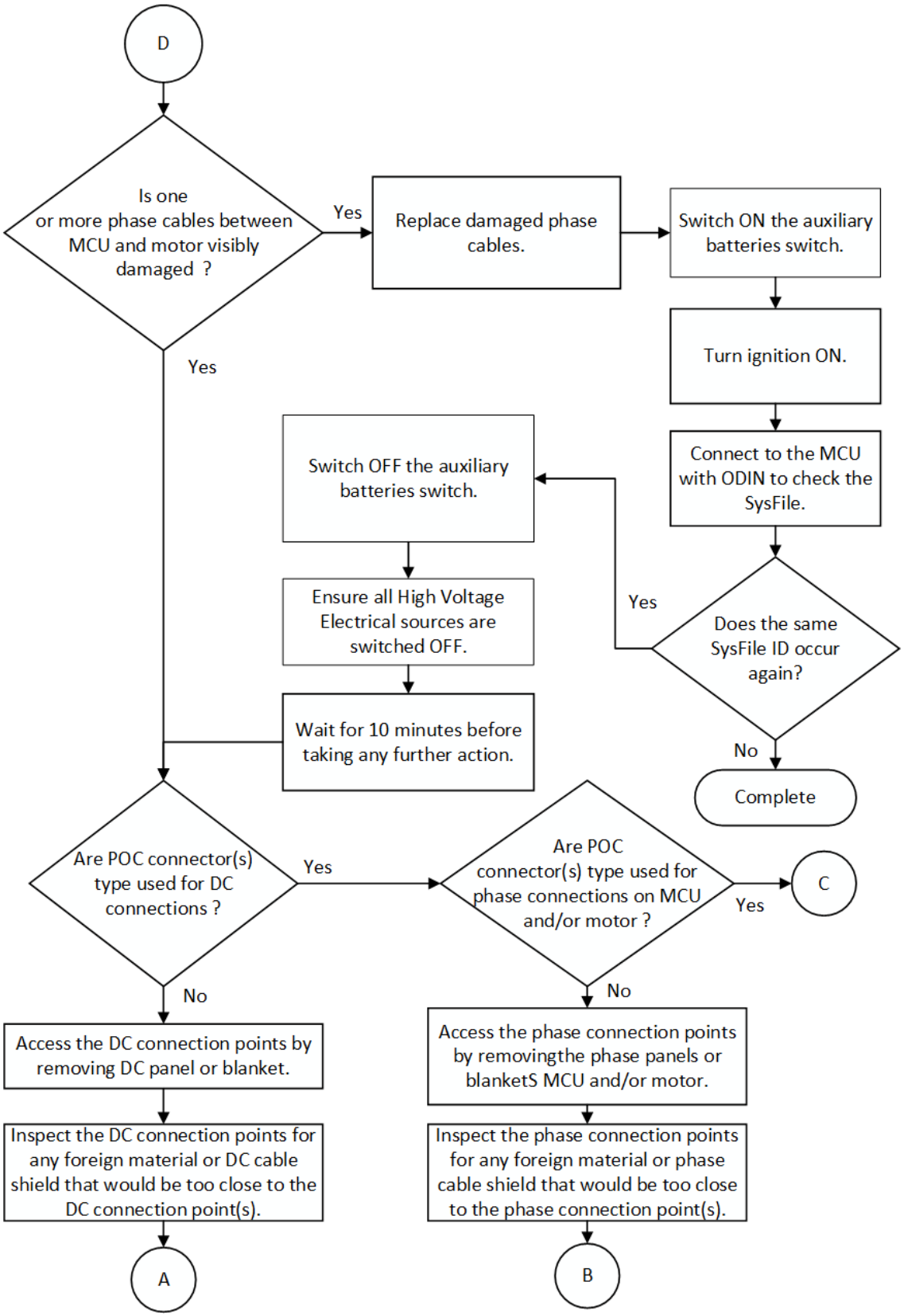
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

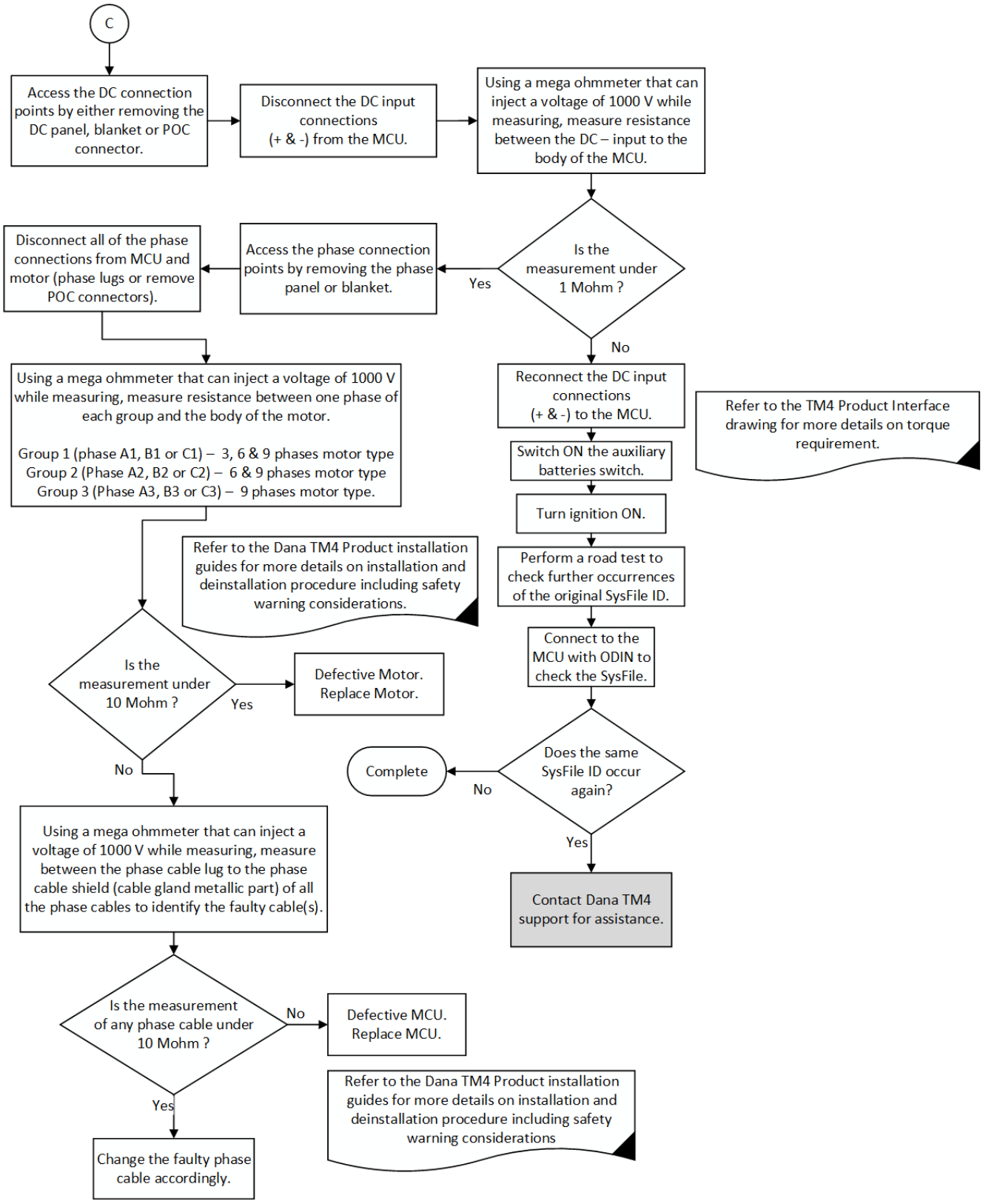
Related Process

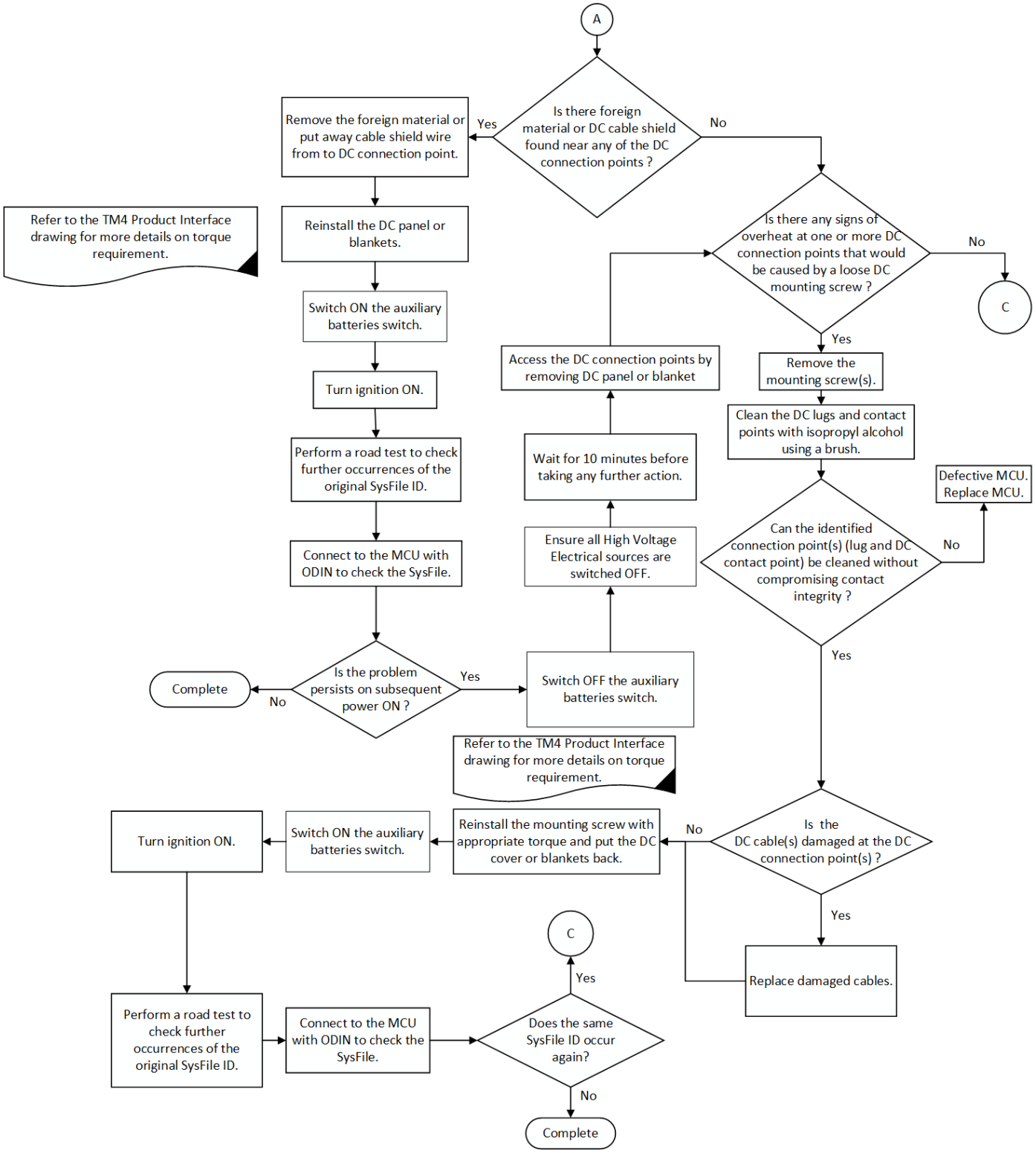
The TT31 call the following process:

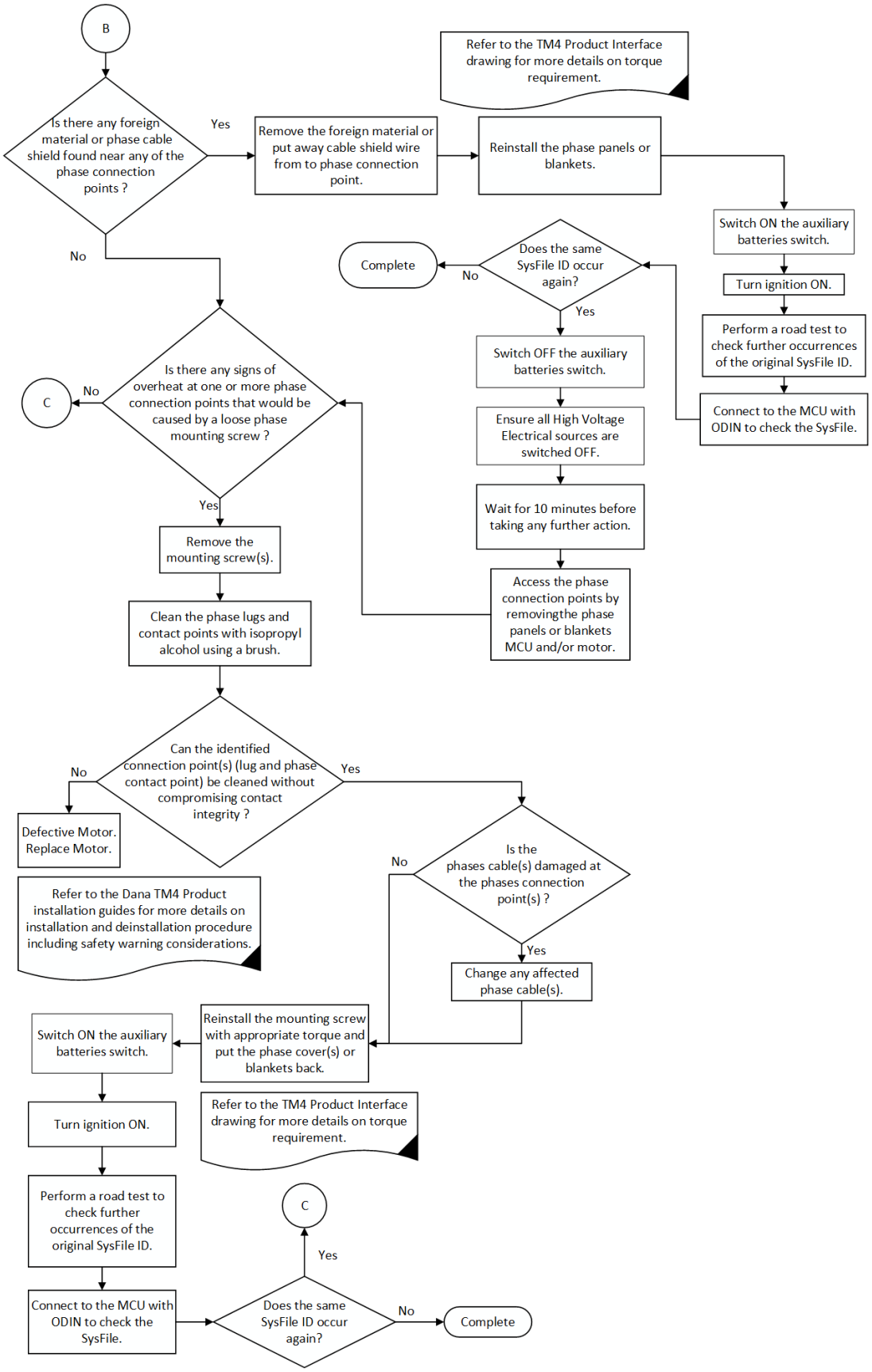
- Appendix 6: Update Software


Troubleshooting Tree 31
Are there other systems connected on the same MCU DC side that reports or could have a sudden loss of insulation ?
Yes
Investigate / correct the issue with the other system.
No
Turn ignition ON.
Connect to the MCU with ODIN.
Note the software version on the status bar.
Access to your system and open all MCU, MOTOR and SOFTWARE subfolders under your system.
Check the compatibility of the software flashed to the MCU with the one published on the Dana TM4 extranet site for your system.
Is the software package flashed to the MCU is the up to date software as published on the Dana TM4 extranet site for your system ?
No
Download and execute the software package from the Dana TM4 extranet site.
Turn ignition OFF.
Flash the up to date software package to the MCU. Refer to the Appendix section "Update Software".
Turn ignition ON.
Perform a road test to check further occurrences of the original SysFile ID.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
D


D
Is one or more phase cables between MCU and motor visibly damaged ?
Yes
Replace damaged phase cables.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
No
Complete
Yes
Are POC connector(s) type used for DC connections ?
Yes
Are POC connector(s) type used for phase connections on MCU and/or motor ?
Yes
C
No
Access the DC connection points by removing DC panel or blanket.
Inspect the DC connection points for any foreign material or DC cable shield that would be too close to the DC connection point(s).
A
No
Access the phase connection points by removingthe phase panels or blanketS MCU and/or motor.
Inspect the phase connection points for any foreign material or phase cable shield that would be too close to the phase connection point(s).
B


C
Access the DC connection points by either removing the DC panel, blanket or POC connector.
Disconnect the DC input connections (+ & -) from the MCU.
Using a mega ohmmeter that can inject a voltage of 1000 V while measuring, measure resistance between the DC – input to the body of the MCU.
Is the measurement under 1 Mohm ?
Yes
Access the phase connection points by removing the phase panel or blanket.
Disconnect all of the phase connections from MCU and motor (phase lugs or remove POC connectors).
No
Reconnect the DC input connections (+ & -) to the MCU.
Refer to the TM4 Product Interface drawing for more details on torque requirement.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Perform a road test to check further occurrences of the original SysFile ID.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Contact Dana TM4 support for assistance.
Using a mega ohmmeter that can inject a voltage of 1000 V while measuring, measure resistance between one phase of each group and the body of the motor.
Group 1 (phase A1, B1 or C1) – 3, 6 & 9 phases motor type
Group 2 (Phase A2, B2 or C2) – 6 & 9 phases motor type
Group 3 (Phase A3, B3 or C3) – 9 phases motor type.
Refer to the Dana TM4 Product installation guides for more details on installation and deinstallation procedure including safety warning considerations.
Is the measurement under 10 Mohm ?
Yes
Defective Motor. Replace Motor.
No
Using a mega ohmmeter that can inject a voltage of 1000 V while measuring, measure between the phase cable lug to the phase cable shield (cable gland metallic part) of all the phase cables to identify the faulty cable(s).
Is the measurement of any phase cable under 10 Mohm ?
No
Defective MCU. Replace MCU.
Refer to the Dana TM4 Product installation guides for more details on installation and deinstallation procedure including safety warning considerations
Yes
Change the faulty phase cable accordingly.


A
Is there foreign material or DC cable shield found near any of the DC connection points ?
Yes
Remove the foreign material or put away cable shield wire from to DC connection point.
Reinstall the DC panel or blankets.
Refer to the TM4 Product Interface drawing for more details on torque requirement.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Perform a road test to check further occurrences of the original SysFile ID.
Connect to the MCU with ODIN to check the SysFile.
Is the problem persists on subsequent power ON ?
No
Complete
Yes
Switch OFF the auxiliary batteries switch.
Refer to the TM4 Product Interface drawing for more details on torque requirement.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Access the DC connection points by removing DC panel or blanket
Is there any signs of overheat at one or more DC connection points that would be caused by a loose DC mounting screw ?
No
C
Yes
Remove the mounting screw(s).
Clean the DC lugs and contact points with isopropyl alcohol using a brush.
Can the identified connection point(s) (lug and DC contact point) be cleaned without compromising contact integrity ?
No
Defective MCU. Replace MCU.
Yes
Is the DC cable(s) damaged at the DC connection point(s) ?
No
Yes
Replace damaged cables.
Reinstall the mounting screw with appropriate torque and put the DC cover or blankets back.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Perform a road test to check further occurrences of the original SysFile ID.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
C
No
Complete


B
Is there any foreign material or phase cable shield found near any of the phase connection points ?
Yes
Remove the foreign material or put away cable shield wire from to phase connection point.
Refer to the TM4 Product Interface drawing for more details on torque requirement.
Reinstall the phase panels or blankets.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Perform a road test to check further occurrences of the original SysFile ID.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait for 10 minutes before taking any further action.
Access the phase connection points by removingthe phase panels or blankets MCU and/or motor.
No
Is there any signs of overheat at one or more phase connection points that would be caused by a loose phase mounting screw ?
C
No
Yes
Remove the mounting screw(s).
Clean the phase lugs and contact points with isopropyl alcohol using a brush.
Can the identified connection point(s) (lug and phase contact point) be cleaned without compromising contact integrity ?
No
Yes
Defective Motor. Replace Motor.
Refer to the Dana TM4 Product installation guides for more details on installation and deinstallation procedure including safety warning considerations.
Is the phases cable(s) damaged at the phases connection point(s) ?
No
Yes
Change any affected phase cable(s).
Reinstall the mounting screw with appropriate torque and put the phase cover(s) or blankets back.
Refer to the TM4 Product Interface drawing for more details on torque requirement.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Perform a road test to check further occurrences of the original SysFile ID.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
C
No
Complete

TT32: Motor Speed reached Maximum

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x3210 0x3211	The motor speed reached its limit in forward or backward direction and caused the system to go in a failure state	**1.** Motor speed is too high - Torque derated but something else preventing the speed to reduce. **2.** MCU speed setting parameters wrongly configured (start, end and speed limit derating in forward or backward direction). **3.** Defective MCU. **4.** Defective motor resolver.

Description

The Troubleshooting Tree 32 indicates an error where the motor speed reached the maximum speed, in either direction, which cause the system to go into the defective state.

The maximum speed for the motor depends on your system application. With ODIN tool check the value of the forward and backward max speed and compare them to your specific system specifications or the preset values from the Operation and Maintenance guide.

The maximum speed limit might be reach while the truck was in a downhill. It is possible the driver uses the mechanical brakes to slow down the vehicle.

The motor sensor cable or the motor sensor connector on the MCU or the motor might cause the issue.

The MCU and/or the motor resolver themselves may be defective.

Note: If the MCU goes in failure, it will capture a BlackBox upon the high voltage battery reached the high limit error. The BlackBox can then be consulted via ODIN tool to see if the angle waveform (saw tooth) is straight on each rise and fall edges.

Note: Note on the maximum speed parameters
By default, the maximum speed parameters (Motor.SpdFwdMax and Motor.SpdBwdMax) are set to the maximum speed the system can achieve. They can be set to lower values by the customer. The maximum speed fault will therefore trigger when the speed (forward or backward) reach the parameter setting (forward or backward).

Note: Refer to the Operation and Maintenance guide for more details on the speed parameters settings.

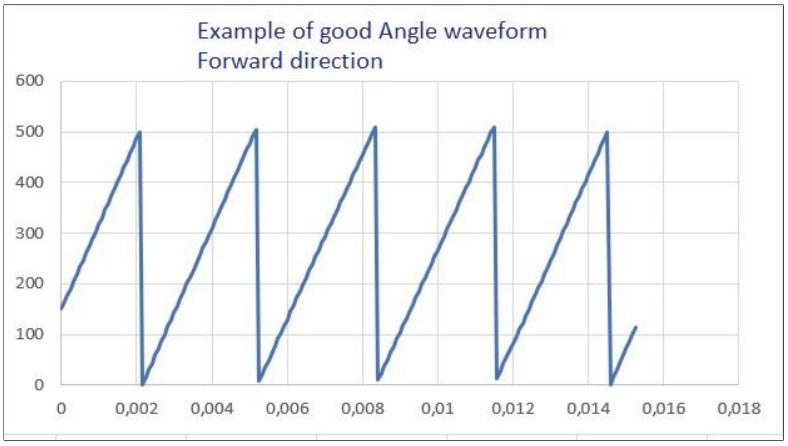
Note: Refer to the System Specification document for more details on Overspeed range limit.

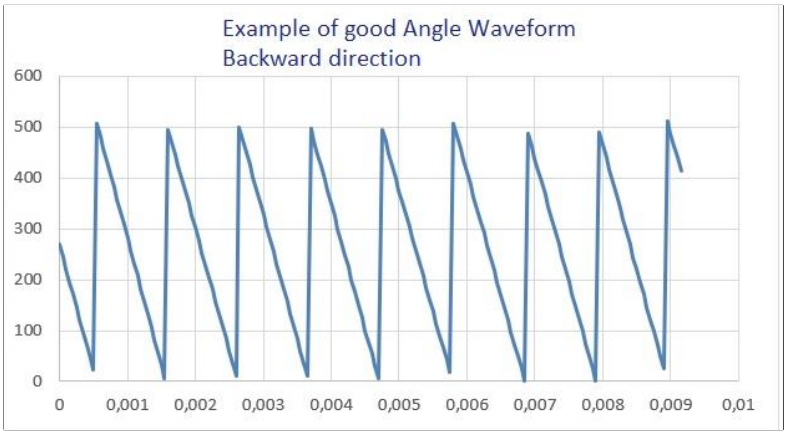
Note: on maximum speed reached
It is possible to reach maximum speed limit regardless of the speed derating in the case the vehicle is going down a downhill slope and the mechanical brake are not used to slow down the vehicle**.** In this case, it is imperative that the driver act on the mechanical brakes to slow down the vehicle**.** The back EMF at speeds higher than the overspeed range of the system could potentially damage the MCU.

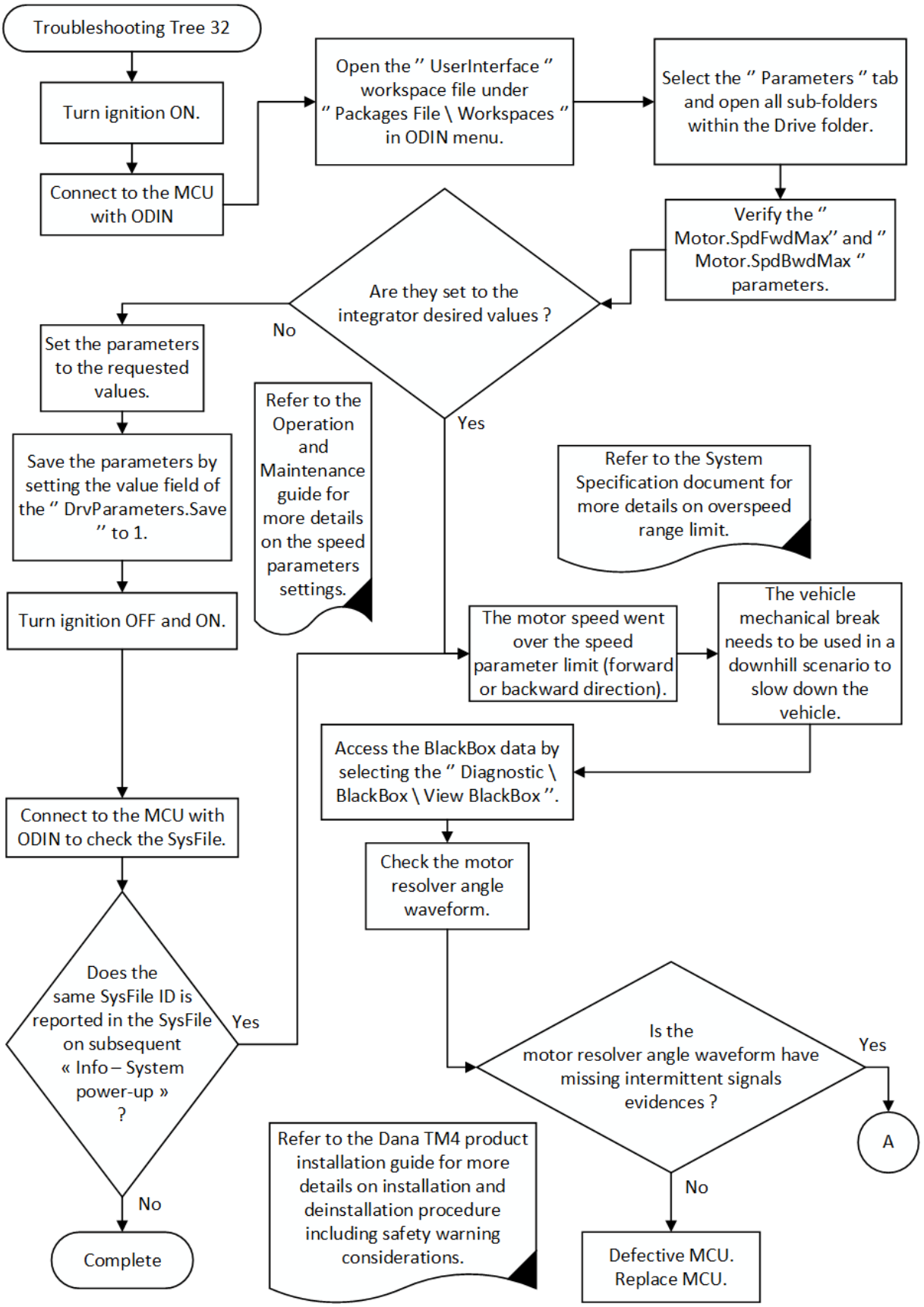
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

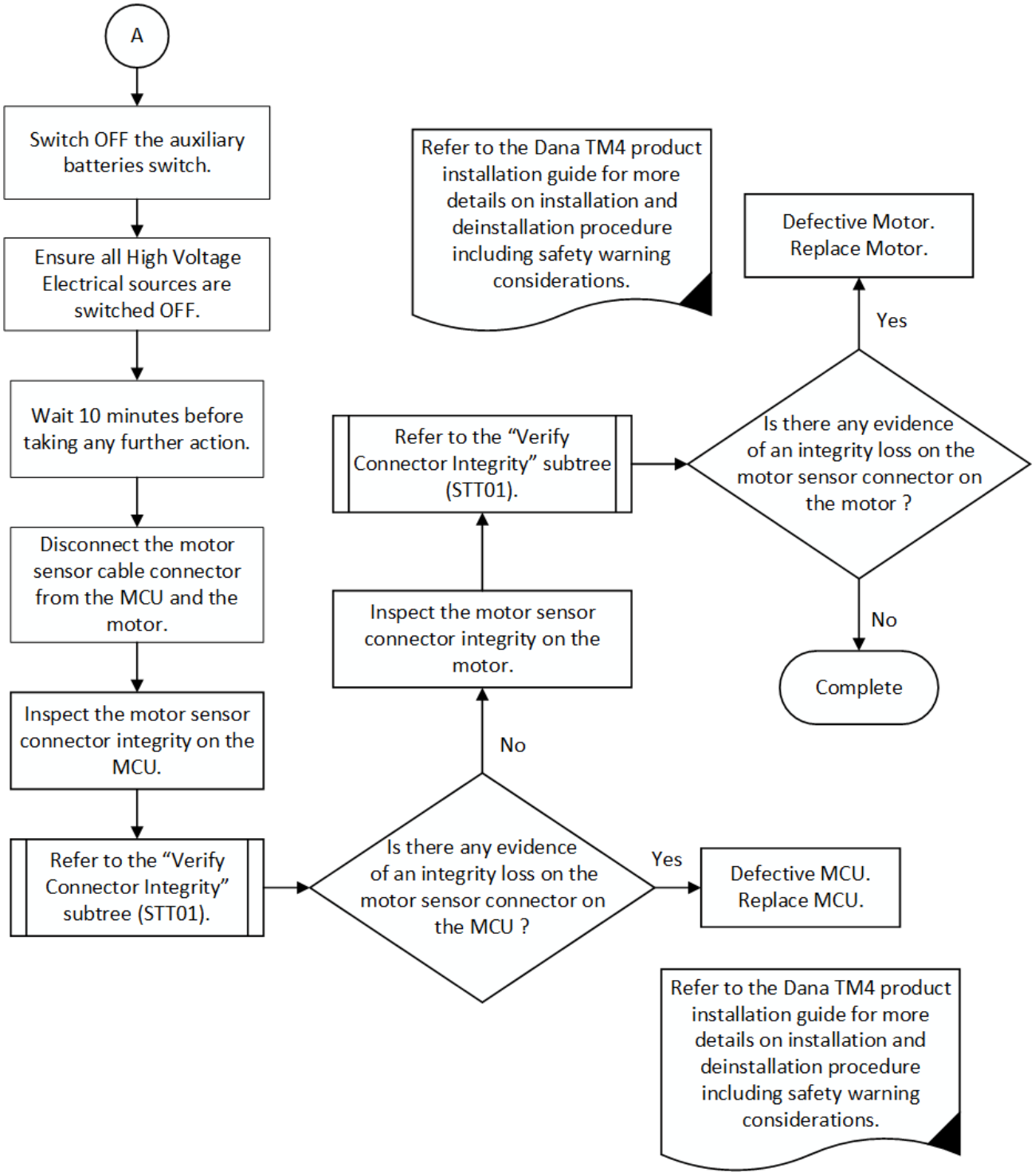
See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Note: Regarding the resolver angle waveform, if the MCU goes in faulty state, it will capture a BlackBox upon the reported error(s).
The BlackBox can then be consulted via ODIN tool to see if the angle waveform (saw tooth) is straight on each rising and falling edges.
See below examples of waveform.






Troubleshooting Tree 32
Turn ignition ON.
Connect to the MCU with ODIN
Open the " UserInterface " workspace file under " Packages File \ Workspaces " in ODIN menu.
Select the " Parameters " tab and open all sub-folders within the Drive folder.
Verify the " Motor.SpdFwdMax" and " Motor.SpdBwdMax " parameters.
Are they set to the integrator desired values ?
No
Yes
Set the parameters to the requested values.
Save the parameters by setting the value field of the " DrvParameters.Save " to 1.
Turn ignition OFF and ON.
Refer to the Operation and Maintenance guide for more details on the speed parameters settings.
Refer to the System Specification document for more details on overspeed range limit.
The motor speed went over the speed parameter limit (forward or backward direction).
The vehicle mechanical break needs to be used in a downhill scenario to slow down the vehicle.
Access the BlackBox data by selecting the " Diagnostic \ BlackBox \ View BlackBox ".
Connect to the MCU with ODIN to check the SysFile.
Check the motor resolver angle waveform.
Does the same SysFile ID is reported in the SysFile on subsequent « Info – System power-up » ?
Yes
No
Complete
Is the motor resolver angle waveform have missing intermittent signals evidences ?
Yes
A
No
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
Defective MCU. Replace MCU.


A
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait 10 minutes before taking any further action.
Disconnect the motor sensor cable connector from the MCU and the motor.
Inspect the motor sensor connector integrity on the MCU.
Refer to the "Verify Connector Integrity" subtree (STT01).
Is there any evidence of an integrity loss on the motor sensor connector on the MCU ?
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
No
Inspect the motor sensor connector integrity on the motor.
Refer to the "Verify Connector Integrity" subtree (STT01).
Is there any evidence of an integrity loss on the motor sensor connector on the motor ?
Yes
Defective Motor. Replace Motor.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.
No
Complete

TT33: Critical low frequency process overrun

System Mode	Referred by SysFile ID	Condition	Possible Causes
Defective	0x3303	The internal software process exceeded its processing limit.	**1.** No issue. Warning listed as error if reported at time 0:00:00 after power up. **2.** MCU software error.

Description

The Troubleshooting Tree 33 indicates an error where the internal software process reached its processing limit and can't perform any more tasks.

If the SysFile ID was raised at 00:00 seconds after start up this event is a minor event, this should be considered as a warning.

If the SysFile occurred after 00:00 seconds then the MCU software might be outdated. After updating the MCU software if there are more occurrences contact Dana TM4 to continue troubleshooting.

Note: regarding the SysFile
If that error is listed as the first event at 0:00 second from the unit power ON, this event can be considered as a warning and does not affect functionality.
Otherwise, if this error is listed at time > 0:00 second, this event will put the MCU in error.

Note: regarding this type of error
If the software is the latest version as published on the Dana TM4 extranet site and this error is listed at > 0:00 second after the « Info – System power-up » event, this indicates that there is an issue with the software.

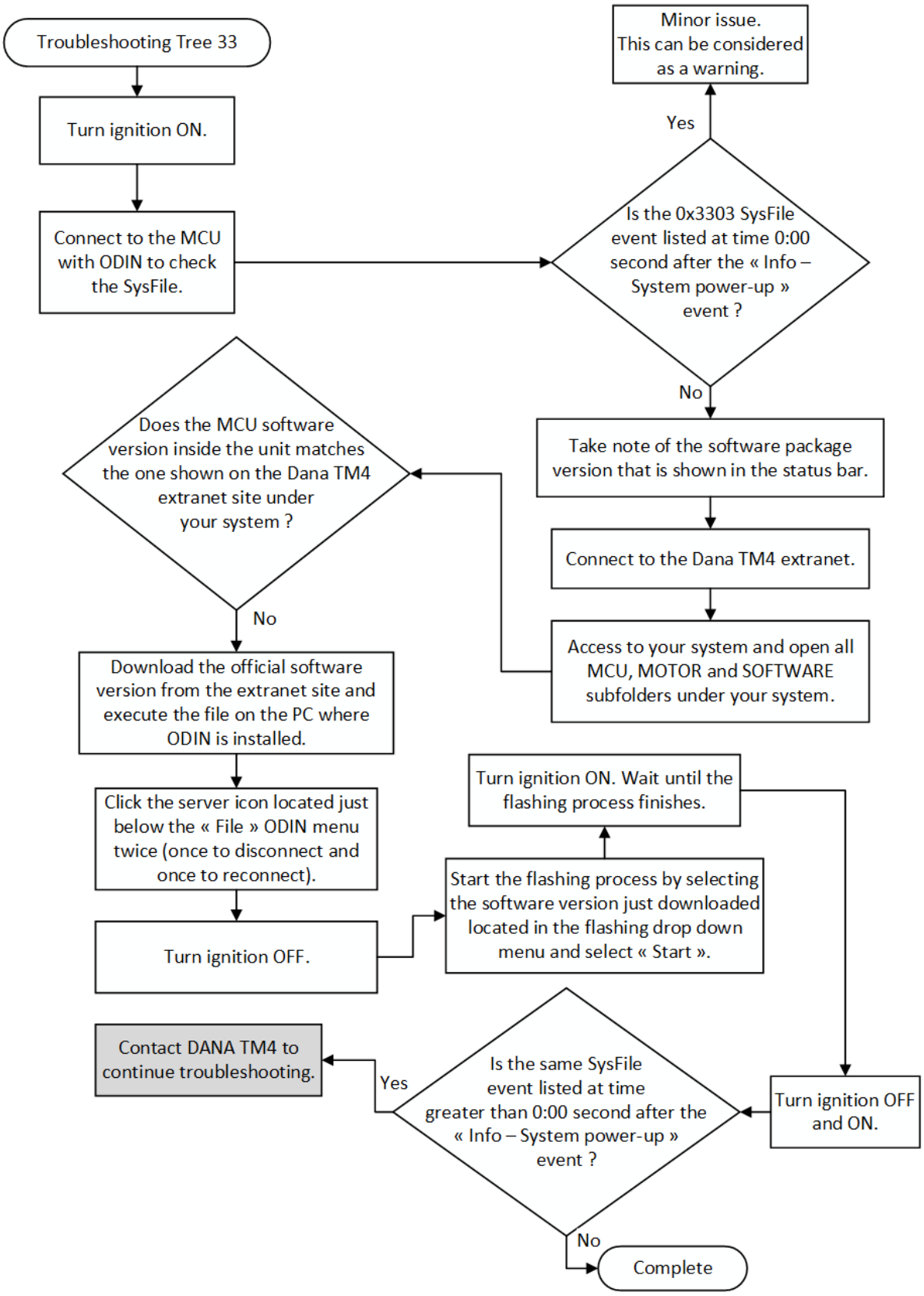
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the procedure of troubleshooting tree below.

See "Safety Warnings" and "Troubleshooting Tips" sections for general guidelines on system diagnostics.

Related Process

The TT33 call the following process:

- Appendix 6: Update Software


Troubleshooting Tree 33
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Is the 0x3303 SysFile event listed at time 0:00 second after the « Info – System power-up » event ?
Yes
Minor issue. This can be considered as a warning.
No
Take note of the software package version that is shown in the status bar.
Connect to the Dana TM4 extranet.
Access to your system and open all MCU, MOTOR and SOFTWARE subfolders under your system.
Does the MCU software version inside the unit matches the one shown on the Dana TM4 extranet site under your system ?
No
Download the official software version from the extranet site and execute the file on the PC where ODIN is installed.
Click the server icon located just below the « File » ODIN menu twice (once to disconnect and once to reconnect).
Turn ignition OFF.
Start the flashing process by selecting the software version just downloaded located in the flashing drop down menu and select « Start ».
Turn ignition ON. Wait until the flashing process finishes.
Turn ignition OFF and ON.
Is the same SysFile event listed at time greater than 0:00 second after the « Info – System power-up » event ?
Yes
Contact DANA TM4 to continue troubleshooting.
No
Complete

TT34: VMU Command Out-of-Range or Invalid

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x4001 0x4002 0x4003 0x4004 0x4005 0x4006 0x4007 0x4008 0x4009 0x400A 0x400B 0x400C 0x400D 0x400E 0x400F 0x4010 0x4011	VMU command is out of range or is invalid.	**1.** Verify MCU CAN protocol document for protocol requirements.

Description

The Troubleshooting Tree 34 indicates an error where the command from the VMU is either out of range or is an invalid command.

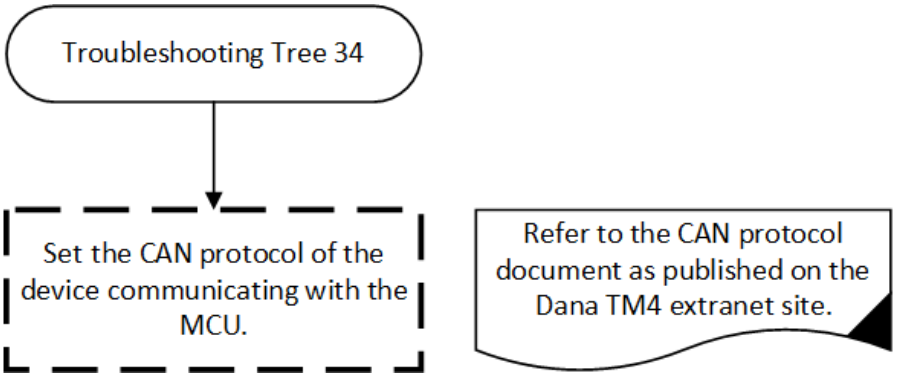
The command did not match what was required by the CAN protocol.

The CAN network might cause the issue fixed. Refer to the CAN protocol document published on the Dana TM4 extranet site.

Note: Refer to the CAN protocol document as published on the Dana TM4 extranet site.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 34
Set the CAN protocol of the device communicating with the MCU.
Refer to the CAN protocol document as published on the Dana TM4 extranet site.

TT35: CAN Communication Error

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x4013 0x4014 0x4015 0x4703	VMU command timed out. Sequencer Detected a CAN Communication Error	**1.** Verify MCU CAN protocol document for protocol requirements (controller issue). **2.** Defective CAN connection (Cable or harness). **3.** Defective CAN network. **4.** Defective MCU.

Description

The Troubleshooting Tree 35 indicates a warning where the VMU command is timed out because it was not received within the CAN timeout limit. The sequencer detected a CAN communication error.

There may be an issue with the controller. Make sure the controller complies to the CAN protocol defined in the CAN protocol document when communication with the MCU.

The VMU/ECU harness interface connector for integrity loss might be causing an error in the CAN communications.

The CAN network might cause the issue fixed. Refer to the CAN protocol document published on the Dana TM4 extranet site.

The MCU itself may be defective.

Note: Refer to the CAN protocol document as published on the Dana TM4 extranet site.

Note: on CAN termination on a CAN bus
For optimised communication on a CAN bus, there should be a termination resistor of 120 ohms between the CAN lines (high and low) at one end of the CAN bus and another termination resistor of 120 ohms between the CAN lines at the other end of the CAN bus. This makes a resultant end termination of 60 ohms.

Note: Refer to the MCU installation guide for more details on installation and deinstallation procedure including safety warning considerations

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics

.

Connector type 1 and type 2 pinouts.

Connector type 1

Connector type 2

Pin	Signal names
E	V AUX +
F	
L	V AUX -(Chassis)
M	
G	IGNITION
A	CAN1L
B	CAN1H
C	CAN2L
D	CAN2H
J	HVIL
K	HVIL
H	Emergency stop

Pin	Signal names
15	V AUX +
8	
22	V AUX -
23	
1	IGNITION
9	CAN1L
16	CAN1H
2	CAN2L
10	CAN2H
18	HVIL_IN
19	HVIL_OUT
5	ANALOG1
13	ANALOG3
20	ANALOG2
6	DIGITAL INPUT 1
14	DIGITAL INPUT 3
21	DIGITAL INPUT 2
7	HS_OUT
17	GND_SENSORS
3	CAN SHIELD
11	5V_SENSOR
4	PWM1_OUT
12	PWM2_OUT

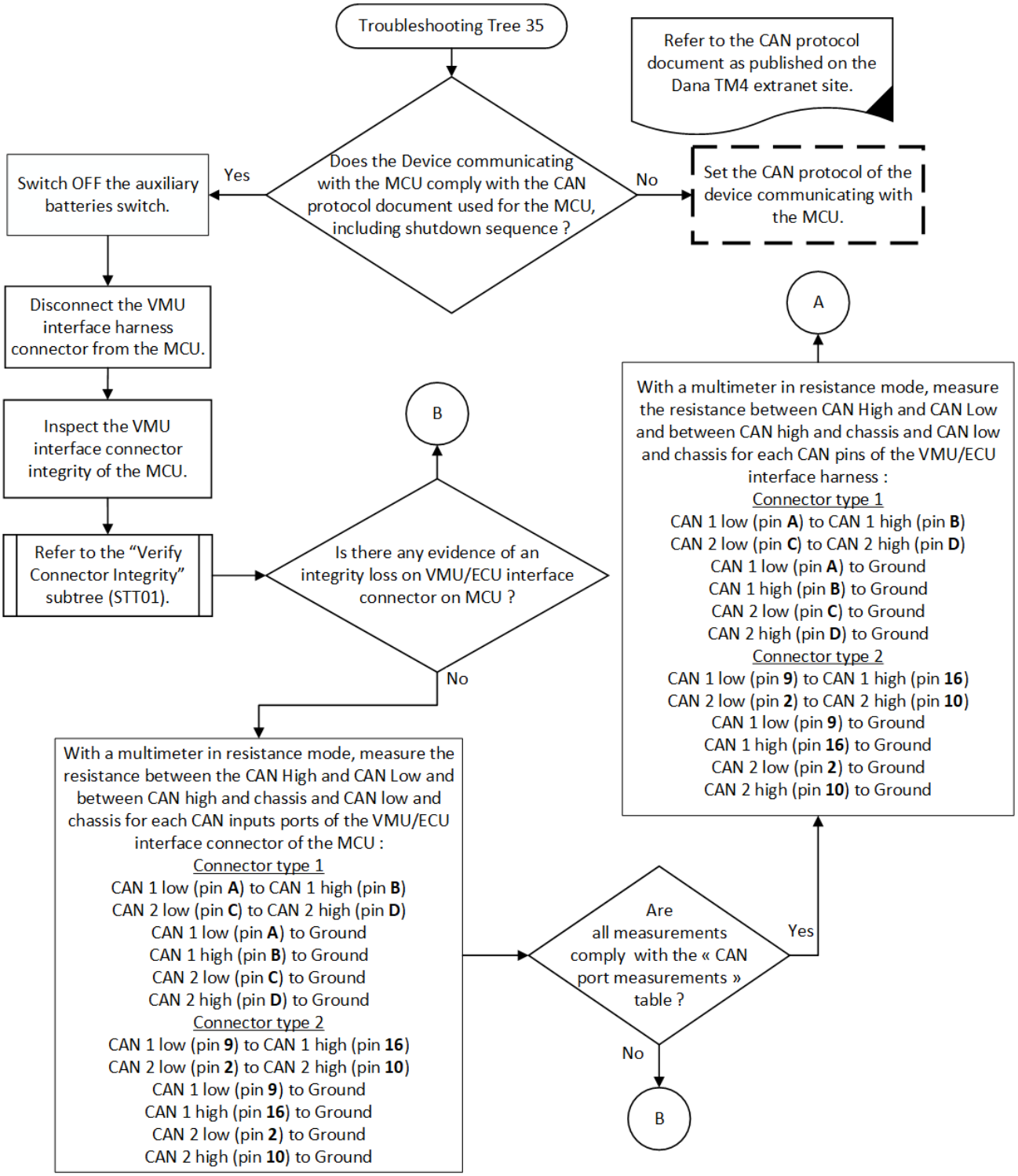
Expected resistance measurement between CAN ports.

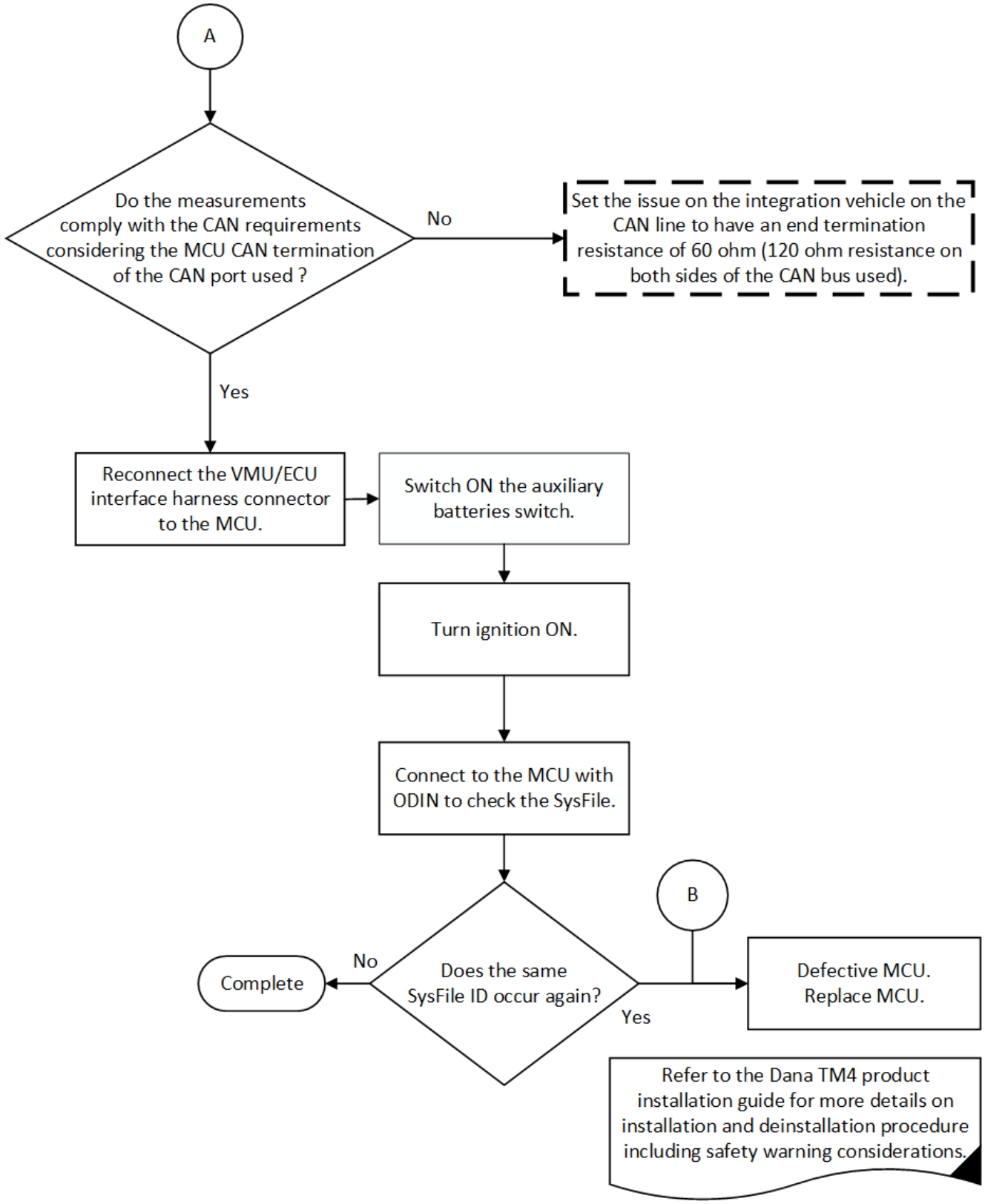
CAN port measurements

Measure between (See note 1)	Measurement detail	Expected resistance value
CAN1 low to CAN1 high	CAN termination of CAN port 1 (Differential measurement)	120 Ω ± 5% (See note 2)
CAN2 low to CAN2 high	CAN termination of CAN port 2 (Differential measurement)	2.6 KΩ ± 5%
CAN1 low to MCU chassis	Common mode measurement of CAN1 low	> 60 KΩ
CAN1 high to MCU chassis	Common mode measurement of CAN1 high	> 60 KΩ
CAN2 low to MCU chassis	Common mode measurement of CAN2 low	> 60 KΩ
CAN2 high to MCU chassis	Common mode measurement of CAN2 high	> 60 KΩ

Note

1. The pinout information can also be found in the MCU installation guide.
2. Depending of the product type, the CAN termination resistance of CAN port 1 can be 2.6 KΩ ± 5%.


Troubleshooting Tree 35
Does the Device communicating with the MCU comply with the CAN protocol document used for the MCU, including shutdown sequence ?
Yes
No
Switch OFF the auxiliary batteries switch.
Refer to the CAN protocol document as published on the Dana TM4 extranet site.
Set the CAN protocol of the device communicating with the MCU.
Disconnect the VMU interface harness connector from the MCU.
Inspect the VMU interface connector integrity of the MCU.
Refer to the "Verify Connector Integrity" subtree (STT01).
Is there any evidence of an integrity loss on VMU/ECU interface connector on MCU ?
B
A
With a multimeter in resistance mode, measure the resistance between CAN High and CAN Low and between CAN high and chassis and CAN low and chassis for each CAN pins of the VMU/ECU interface harness :
Connector type 1
CAN 1 low (pin A) to CAN 1 high (pin B)
CAN 2 low (pin C) to CAN 2 high (pin D)
CAN 1 low (pin A) to Ground
CAN 1 high (pin B) to Ground
CAN 2 low (pin C) to Ground
CAN 2 high (pin D) to Ground
Connector type 2
CAN 1 low (pin 9) to CAN 1 high (pin 16)
CAN 2 low (pin 2) to CAN 2 high (pin 10)
CAN 1 low (pin 9) to Ground
CAN 1 high (pin 16) to Ground
CAN 2 low (pin 2) to Ground
CAN 2 high (pin 10) to Ground
With a multimeter in resistance mode, measure the resistance between the CAN High and CAN Low and between CAN high and chassis and CAN low and chassis for each CAN inputs ports of the VMU/ECU interface connector of the MCU :
Connector type 1
CAN 1 low (pin A) to CAN 1 high (pin B)
CAN 2 low (pin C) to CAN 2 high (pin D)
CAN 1 low (pin A) to Ground
CAN 1 high (pin B) to Ground
CAN 2 low (pin C) to Ground
CAN 2 high (pin D) to Ground
Connector type 2
CAN 1 low (pin 9) to CAN 1 high (pin 16)
CAN 2 low (pin 2) to CAN 2 high (pin 10)
CAN 1 low (pin 9) to Ground
CAN 1 high (pin 16) to Ground
CAN 2 low (pin 2) to Ground
CAN 2 high (pin 10) to Ground
Are all measurements comply with the « CAN port measurements » table ?
Yes
No
B


A
Do the measurements comply with the CAN requirements considering the MCU CAN termination of the CAN port used ?
No
Set the issue on the integration vehicle on the CAN line to have an end termination resistance of 60 ohm (120 ohm resistance on both sides of the CAN bus used).
Yes
Reconnect the VMU/ECU interface harness connector to the MCU.
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
B
Does the same SysFile ID occur again?
No
Complete
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT36: Position and/or Temperature Sensor Error

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x050B 0x050C	Deactivation process couldn't be successfully executed or timeout occurred while going in the deactivation process.	**1.** The VMU/ECU has sent a shutdown request to the MCU during operation, causing this error to be raised. **2.** Defective MCU.

Description

The event category 36 indicates a warning where the Position sensor and/or the temperature sensors are having errors.

The SysFile IDs occur in the same session (under the same ‘’ Info – System Power Up’’) as the ‘’ Back EMF Motor reduction mechanism activated (phases are short-circuited)’’ error.
The VMU/ECU might have sent a shutdown request to the MCU while the motor speed was greater than given threshold.

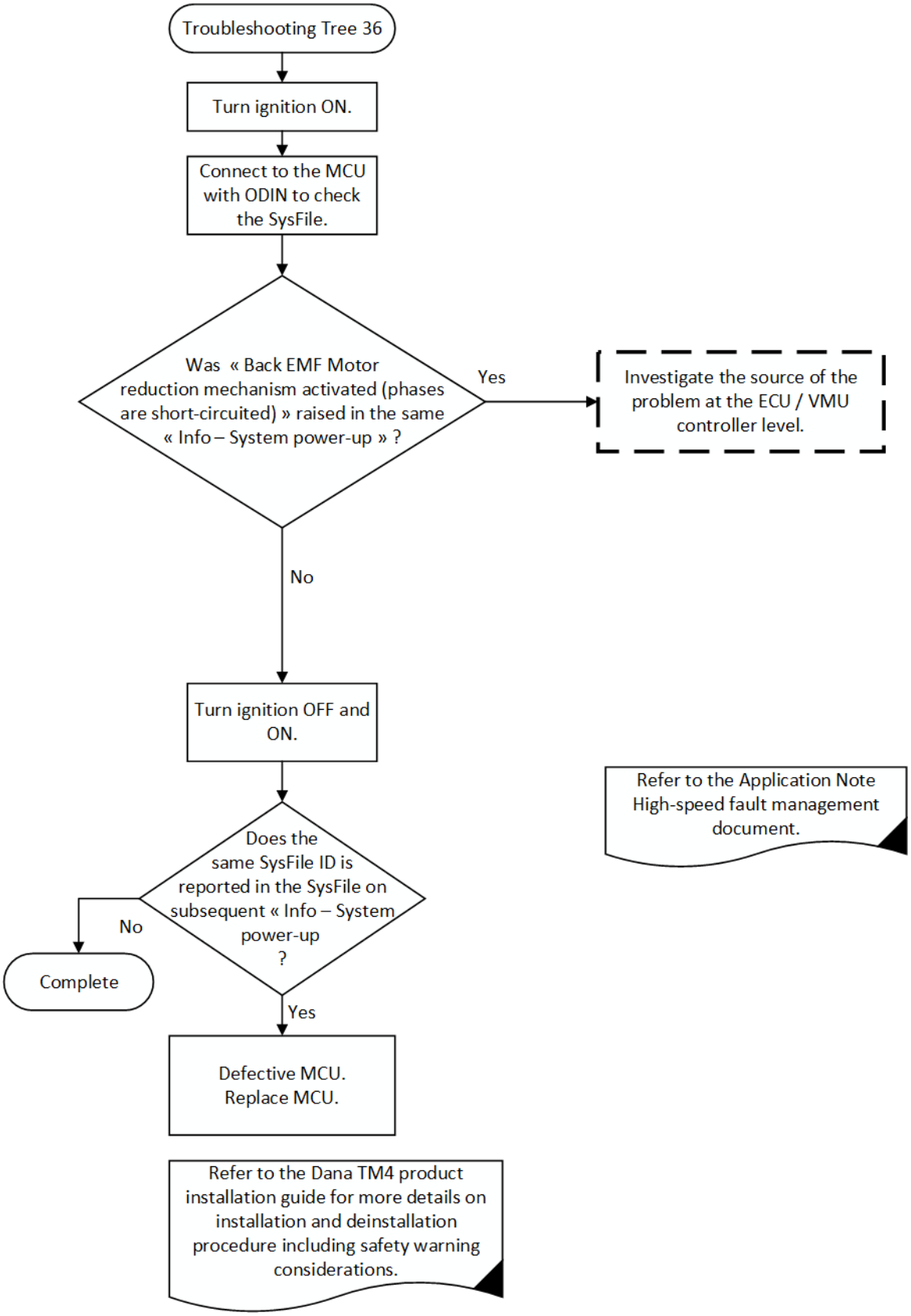
The MCU itself may be defective.

Note: on shutdown request while vehicle speed is high
The ECU / VMU controller must have sent a shutdown sequence request via CAN message to the MCU that caused the warning
« Back EMF Motor reduction mechanism activated (phases are short-circuited) »" to be raised while the motor speed was greater than the threshold of that warning. The ECU / VMU controller could have registered a fault at its level and shutdown the MCU. In that case, the source of the problem must be investigated at the ECU / VMU controller level.

Note: Refer to the Application Note High-speed fault management document.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics


Troubleshooting Tree 36
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Was « Back EMF Motor reduction mechanism activated (phases are short-circuited) » raised in the same « Info – System power-up » ?
Yes
Investigate the source of the problem at the ECU / VMU controller level.
No
Turn ignition OFF and ON.
Refer to the Application Note High-speed fault management document.
Does the same SysFile ID is reported in the SysFile on subsequent « Info – System power-up ?
No
Complete
Yes
Defective MCU. Replace MCU.
Refer to the Dana TM4 product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

TT37: Sequencer error

System Mode	Referred by SysFile ID	Condition	Possible Causes
Operational	0x0506 0x0507 0x0508 0x0509 0x050A 0x050D	This error is activated by a lower level error.	**1.** Some other error caused the SysFile to be raised.

Description

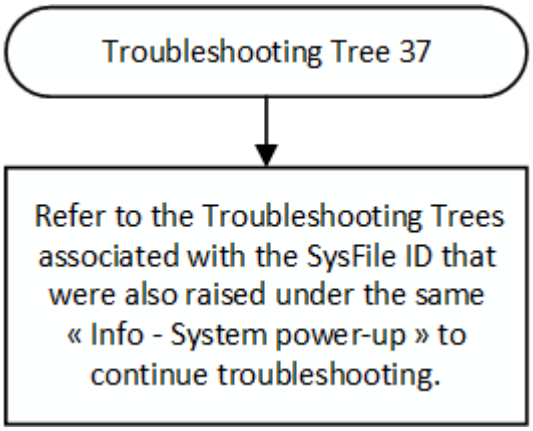
The event category 37 shows a sequencer type error.

These errors are caused by a lower level error type and refer to the errors raised under the same ''Info-System power-up''.

Note: on Sequencer error type
Most of «Sequencer » types errors are considered top level errors. They are triggered from a lower level error type

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the troubleshooting tree procedure below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.


Troubleshooting Tree 37
Refer to the Troubleshooting Trees associated with the SysFile ID that were also raised under the same « Info - System power-up » to continue troubleshooting.

STT01: Verify Connector Integrity

Related TT	External input	Outcome
TT03 TT04 TT05 TT08 TT09 TT10 TT27 TT28	None.	**1.** The connectors have been replaced.

Description

The sub troubleshooting tree “Verify Connector Integrity” deals with the issue where the connectors of different parts of the MCU must be repaired or replaced.

Note: Refer to the TM4 Product installation guide for more details on product connector pinout information.

One pin in bent or broken as well the conductivity fault cause defective MCU and involve in several Troubleshooting Trees.

TM4 ODIN diagnostic tool helps to determine the harness connector faulty.

There is Amphenol connector (see picture on this page) and not Amphenol connector.
The connector is an Amphenol connector, a pin might tend to move toward inside the related system.
For connector not Amphenol connector, pull gently the pin until the locking mechanism engaged.

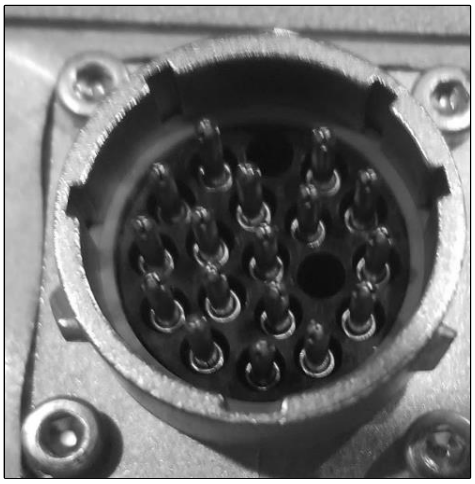
Note: Refer to the TM4 Product installation guide for more details on installation and deinstallation procedure including safety warning considerations.

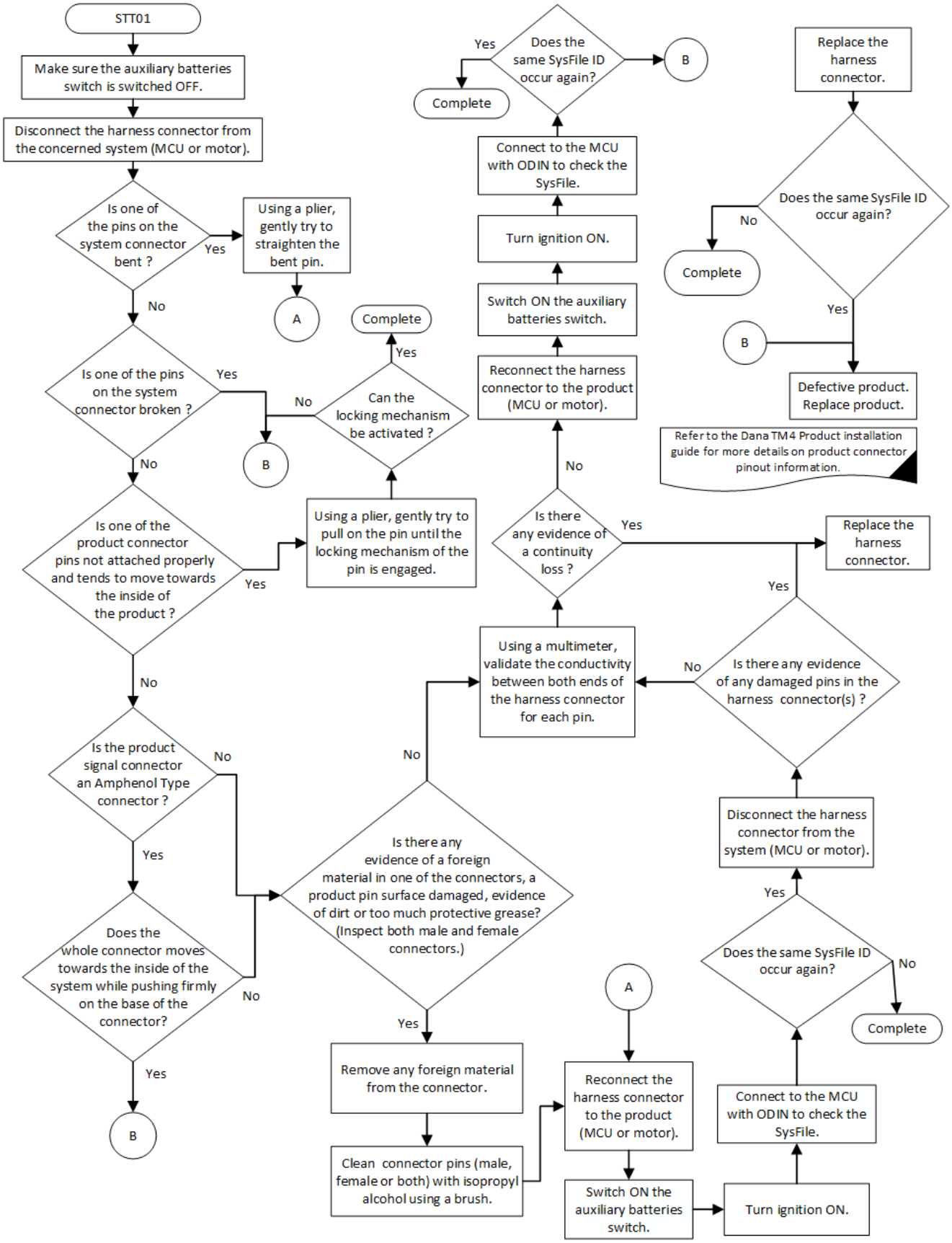
Note: Refer to the TM4 Product installation guide for more details on product connector pinout information.

To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the procedure of troubleshooting tree below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Amphenol type connector:




STT01
Make sure the auxiliary batteries switch is switched OFF.
Disconnect the harness connector from the concerned system (MCU or motor).
Is one of the pins on the system connector bent ?
Yes
Using a plier, gently try to straighten the bent pin.
A
No
Is one of the pins on the system connector broken ?
Yes
No
B
Can the locking mechanism be activated ?
Yes
Complete
No
Is one of the product connector pins not attached properly and tends to move towards the inside of the product ?
Yes
Using a plier, gently try to pull on the pin until the locking mechanism of the pin is engaged.
No
Is the product signal connector an Amphenol Type connector ?
No
Yes
Does the whole connector moves towards the inside of the system while pushing firmly on the base of the connector?
No
Yes
B
Is there any evidence of a foreign material in one of the connectors, a product pin surface damaged, evidence of dirt or too much protective grease? (Inspect both male and female connectors.)
No
Yes
Remove any foreign material from the connector.
Clean connector pins (male, female or both) with isopropyl alcohol using a brush.
Reconnect the harness connector to the product (MCU or motor).
A
Switch ON the auxiliary batteries switch.
Turn ignition ON.
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
Yes
Complete
B
Turn ignition ON.
Switch ON the auxiliary batteries switch.
Reconnect the harness connector to the product (MCU or motor).
No
Is there any evidence of a continuity loss ?
Yes
Replace the harness connector.
Using a multimeter, validate the conductivity between both ends of the harness connector for each pin.
No
Is there any evidence of any damaged pins in the harness connector(s) ?
Yes
Disconnect the harness connector from the system (MCU or motor).
Connect to the MCU with ODIN to check the SysFile.
Does the same SysFile ID occur again?
No
Complete
Yes
Replace the harness connector.
Does the same SysFile ID occur again?
No
Complete
Yes
B
Defective product. Replace product.
Refer to the Dana TM4 Product installation guide for more details on product connector pinout information.

STT02: Verify Cooling Circuit Integrity

Related TT	External input	Outcome
TT20 TT21 TT22 TT23 TT24 TT29	None.	**1.** The cooling system has no problems and can be left alone. **2.** The cooling hoses have a problem and must be physically oved or replaced. **3.** The coolant mixture is not the correct mixture, and it must be replaced. **4.** There is an issue with the radiator.

Description

The sub troubleshooting tree “Verify Cooling Circuit Integrity” deals with the issue where the cooling circuit of the motor and the Motor Control Unit (MCU) must be checked and, if necessary, repaired or replaced.

The lack of coolant, the air within the motor an MCU lead to the system overheat.

A slowdown cooling flaw in the cooling circuit leads to the system overheat.

The cooling agent mixture shall comply with the TM4 Product installation manual recommendations and integration vehicle installation manual.

Note: Refer to integration vehicle installation manual.

Note: Refer to the TM4 Product installation guide for more details on cooling agent mixture.

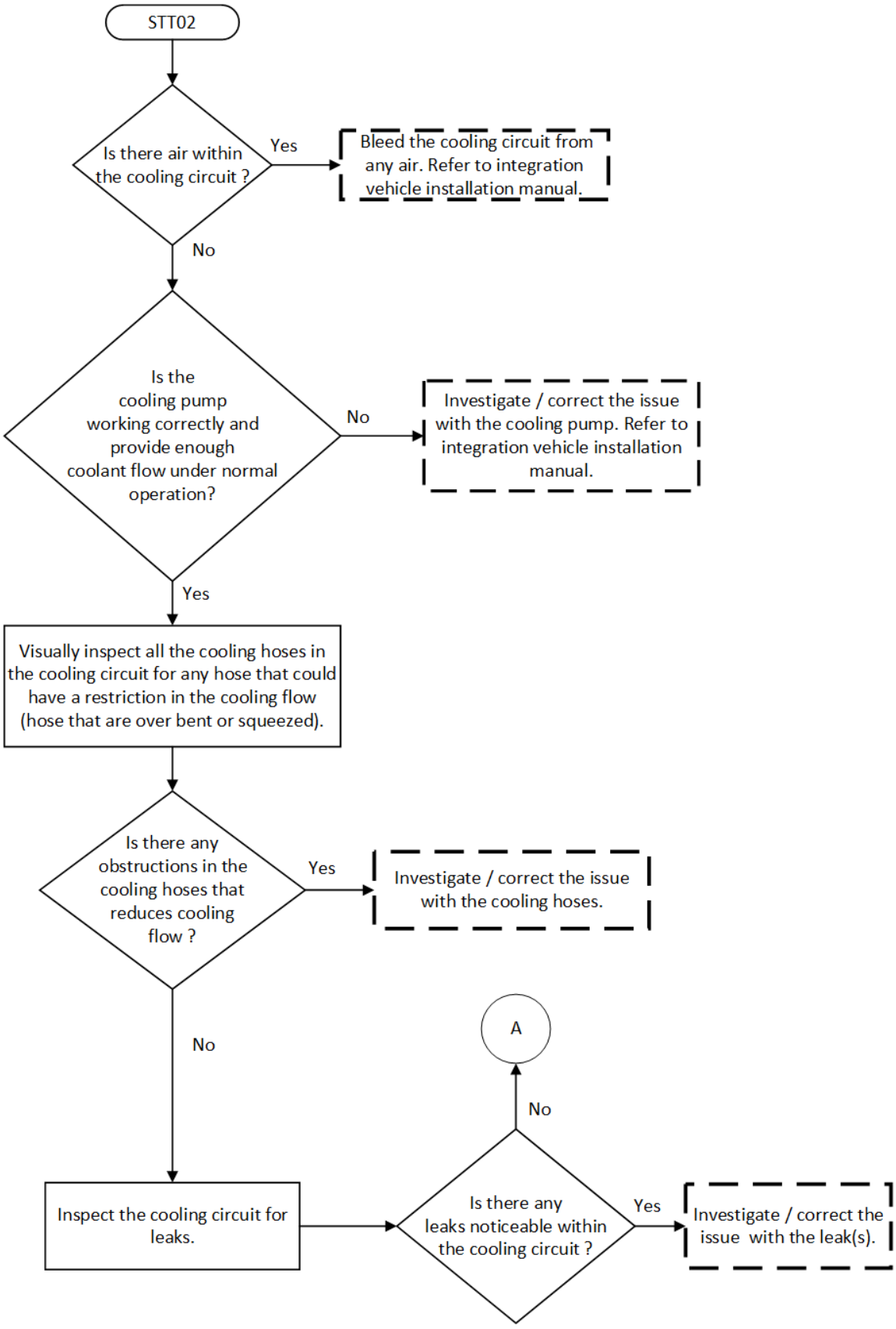
Note: On cooling agent
Wrong cooling agent can create dust / rust in the cooling circuit.

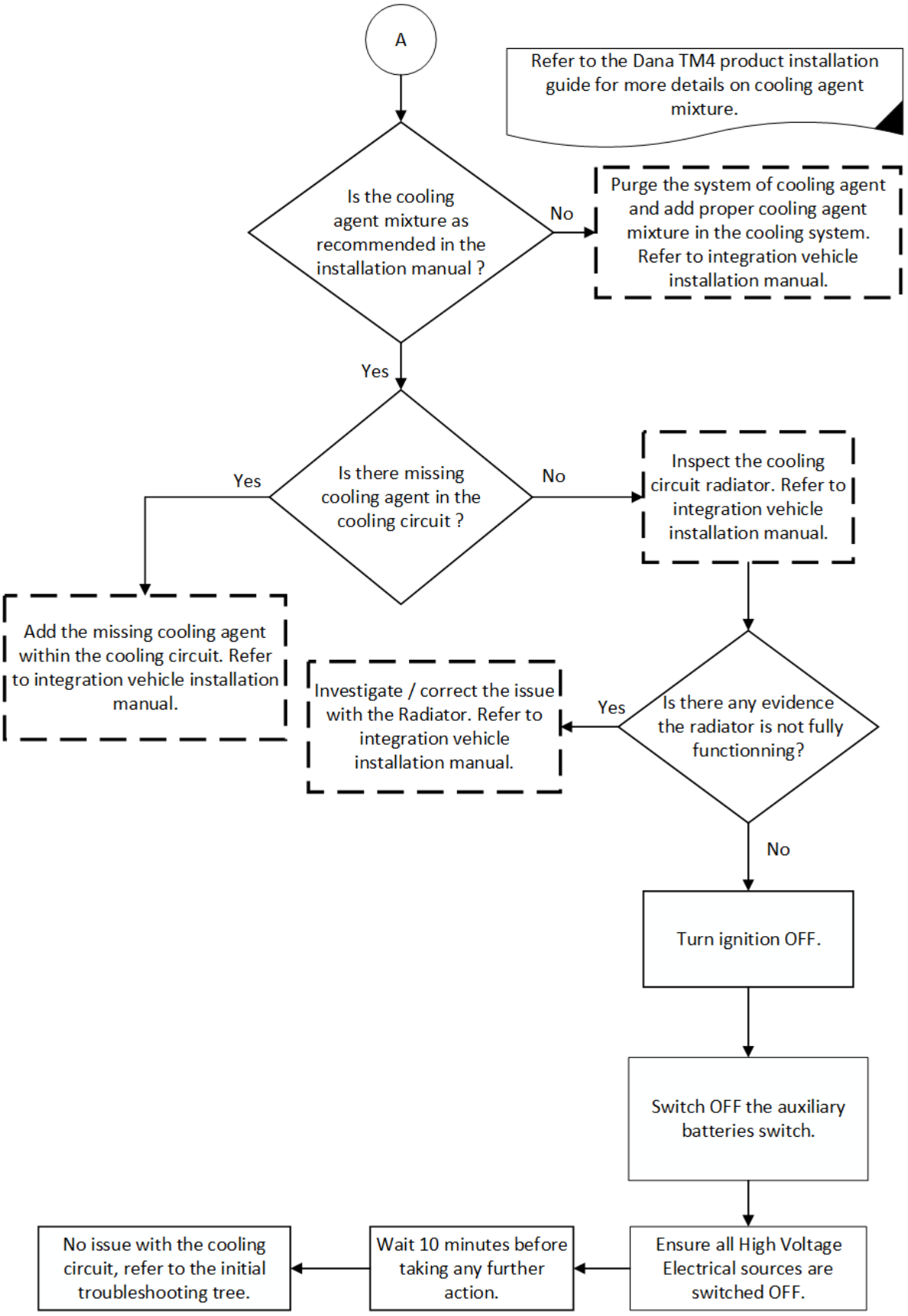
To correctly diagnose the faulty system, connect the Diagnostic Tool (see «Diagnostics» section for test equipment and descriptions) and follow the procedure of troubleshooting tree below.

See “Safety Warnings” and “Troubleshooting Tips” sections for general guidelines on system diagnostics.

Related Process
The STT02 call the following process:

- Appendix 5: Cooling agent precautions.


STT02
Is there air within the cooling circuit ?
Yes
Bleed the cooling circuit from any air. Refer to integration vehicle installation manual.
No
Is the cooling pump working correctly and provide enough coolant flow under normal operation?
No
Investigate / correct the issue with the cooling pump. Refer to integration vehicle installation manual.
Yes
Visually inspect all the cooling hoses in the cooling circuit for any hose that could have a restriction in the cooling flow (hose that are over bent or squeezed).
Is there any obstructions in the cooling hoses that reduces cooling flow ?
Yes
Investigate / correct the issue with the cooling hoses.
No
A
No
Inspect the cooling circuit for leaks.
Is there any leaks noticeable within the cooling circuit ?
Yes
Investigate / correct the issue with the leak(s).


A
Refer to the Dana TM4 product installation guide for more details on cooling agent mixture.
Is the cooling agent mixture as recommended in the installation manual ?
No
Purge the system of cooling agent and add proper cooling agent mixture in the cooling system. Refer to integration vehicle installation manual.
Yes
Is there missing cooling agent in the cooling circuit ?
Yes
No
Inspect the cooling circuit radiator. Refer to integration vehicle installation manual.
Add the missing cooling agent within the cooling circuit. Refer to integration vehicle installation manual.
Is there any evidence the radiator is not fully functionning?
Yes
Investigate / correct the issue with the Radiator. Refer to integration vehicle installation manual.
No
Turn ignition OFF.
Switch OFF the auxiliary batteries switch.
Ensure all High Voltage Electrical sources are switched OFF.
Wait 10 minutes before taking any further action.
No issue with the cooling circuit, refer to the initial troubleshooting tree.

Appendix

Appendix 1: Table of SysFile ID

The following table of the SysFile ID gives the in formation of the diagnostic type, the code description and the related Troubleshooting Tree.

SysFile ID	Diagnostic Type	Description	Troubleshooting Tree
0x0000	Info	SysFile 0x0000 - SysFile cleared	01
0x000A	Warning	SysFile 0x0A	02
0x0313	Warning	Board 0x13 - VAUX too low	03
0x0314	Warning	Board 0x14 - VAUX too high	04
0x0315	Warning	Board 0x15 motor temp sensor shorted to -Vaux	05
0x0316	Warning	Board 0x16 motor temp sensor open or shorted to +Vaux	05
0x0319	Error	Board 0x19 - Abnormal battery current condition as not operational	06
0x031A	Warning	Board #26 - Phase current sensor deactivated (phase 1, 2 or 3)	07
0x031B	Warning	Board #27 - Phase current sensor deactivated (phase 4, 5 or 6)	07
0X031C	Warning	Board #28 - Phase current sensor deactivated (phase 7, 8 or 9)	07
0x031D	Error	Board 0x1D - HVIL voltage input fault	08
0x031E	Error	Board 0x1E - HVIL voltage output fault	09
0x031F	Error	Board 0x2F - HVIL internal fault	10
0x0320	Error	Board 0x20 - HVIL over current	11
0x0321	Warning	Board 0x21 motor temperature sensor A1 was shorted to -Vaux.	05
0x0322	Warning	Board 0x22 motor temperature sensor A1 was disconnected or shorted to +Vaux.	05
0x0323	Warning	Board 0x23 motor temperature sensor B1 was shorted shorted to -Vaux.	05
0x0324	Warning	Board 0x24 motor temperature sensor B1 was disconnected or shorted to +Vaux.	05
0x0325	Warning	Board 0x25 motor temperature sensor C1 was shorted shorted to -Vaux.	05
0x0326	Warning	Board 0x26 motor temperature sensor C1 was disconnected or shorted to +Vaux.	05
0x0504	Error	Sequencer 0x04 - Initialisation timed out	12
0x1000	Error	NvdGlobalSection #1	15
0x1003	Error	NvdGlobalSection #4	16
0x1100	Error	NvdProtectedSection 0x00	15
0x1200	Error	ParamDrv 0x00	15
0x120A	Error	ParamDrv 0x0A - Invalid phase calibration	13
0x1300	Warning	NvdSavSection 0x00	02

SysFile ID	Diagnostic Type	Description	Troubleshooting Tree
0x2200	Warning	ParamMac 0x00	05
0x2209	Error	ParamMac 0x09 - Unsupported motor hardware version	14
0X3100	Warning	Motor Control Inverter 0x00	17
0X3101	Warning	Motor Control Inverter 0x01	17
0x3102	Warning	Motor Control Inverter 0x02	17
0x3103	Warning	Motor Control Inverter 0x03	17
0x3104	Warning	Motor Control Inverter 0x04	17
0x3105	Warning	Motor Control Inverter 0x05	17
0x3106	Warning	Motor Control Inverter 0x06	17
0x3107	Warning	Motor Control Inverter 0x07	17
0x3108	Warning	Motor Control Inverter 0x08	17
0x3109	Error	Motor Control Inverter 0x09 - Position sensor hardware fault	05
0x310A	Error	Motor Control Inverter 0x0A - High power battery voltage reached the low limit	18
0x310B	Error	Motor Control Inverter 0x0B - High power battery voltage reached the high limit	19
0x310C	Error	Motor Control Inverter 0x0C - High power battery voltage reached the high limit (H/W detection)	19
0x310D	Error	Motor Control Inverter 0x0D - Temperature too high	20
0x310E	Error	Motor Control Inverter 0x0E - Temperature too high	20
0x310F	Error	Motor Control Inverter 0x0F - Temperature too high	21
0x3110	Error	Motor Control Inverter 0x10 - Temperature too high	21
0x3111	Error	Motor Control Inverter 0x11 - Invalid command	25
0x3112	Error	Motor Control Inverter 0x12 - Temperature too high	22
0x3113	Warning	Motor Control Inverter 0x13 - Back EMF Motor reduction mechanism activated (phases are short-circuited)	26
0x3200	Error	Motor Control Machine 0x00 - MCU phase #1 current reached the maximum	27
0x3201	Error	Motor Control Machine 0x01 - MCU phase #2 current reached the maximum	27
0x3202	Error	Motor Control Machine 0x02 - MCU phase #3 current reached the maximum	27
0x3203	Warning	Motor Control Machine 0x03 - Sum of MCU phase #1_2_3 currents exceeds maximum limit	28
0x3204	Error	Motor Control Machine 0x04 - MCU phase #4 current reached the maximum	27
0x3205	Error	Motor Control Machine 0x05 - MCU phase #5 current reached the maximum	27

SysFile ID	Diagnostic Type	Description	Troubleshooting Tree
0x3206	Error	Motor Control Machine 0x06 - MCU phase #6 current reached the maximum	27
0x3207	Warning	Motor Control Machine 0x07 - Sum of MCU phase #4_5_6 currents exceeds maximum limit	28
0x3208	Error	Motor Control Machine 0x08 - MCU phase #7 current reached the maximum	27
0x3209	Error	Motor Control Machine 0x09 - MCU phase #8 current reached the maximum	27
0x320A	Error	Motor Control Machine 0x0A - MCU phase #9 current reached the maximum	27
0x320B	Warning	Motor Control Machine 0x0B - Sum of MCU phase #7_8_9 currents exceeds maximum limit	28
0x320C	Error	Motor Control Machine 0x0C	29
0x320D	Error	- Motor Control Machine 0x0D	30
0x320E	Error	Motor Control Machine 0x0E - Insulation to chassis fault	31
0x320F	Error	Motor Control Machine 0x0F - Motor temperature	23
0x3210	Error	Motor Control Machine 0x10 - Speed reached its limit in forward direction	32
0x3211	Error	Motor Control Machine 0x11 - Speed reached its limit in backward direction	32
0x3212	Error	Motor Control Machine 0x12 - Invalid motor phase	13
0x3301	Error	Application in Safe Mode	16
0x3303	Error	Application 0x03	33
0x3307	Warning	Invalid Motor Hardware Version	14
0x3400	Warning	Resolver #1 - Parity error	05
0x3401	Warning	Resolver #2 - Abnormal signals	05
0x3402	Warning	Resolver #3 - Broken cos line	05
0x3403	Warning	Resolver #4 - Broken sin line	05
0x3404	Warning	Resolver #5 - Abnormal conversion	05
0x3405	Warning	Resolver #6 - Resolver high temperature	24
0x3406	Warning	Resolver #7 - Delta angle too high	05
0x3407	Warning	Resolver #8 - Resolver errHld pin raised	05
0x3408	Error	Resolver #9 - Position sensor module error	05
0x3500	Warning	One-Wire EEPROM Driver 0x00 - Device presence not detected	05
0x4000	Error	ComClient 0x00 - No CAN mailbox are available for the adapter to use	25
0x4001	Warning	ComClient 0x01 - VmuCommandSafety TorqueCommand is out of range	34
0x4002	Warning	ComClient 0x02 - VmuCommandSafety SpeedCommand is out of range	34

SysFile ID	Diagnostic Type	Description	Troubleshooting Tree
0x4003	Warning	ComClient 0x03 - VmuCommandSafety CommandMode is invalid	34
0x4004	Warning	ComClient 0x04 - VmuCommand2 TorqueCommand is out of range	34
0x4005	Warning	ComClient 0x05 - VmuCommand2 SpeedCommand is out of range	34
0x4006	Warning	ComClient 0x06 - VmuCommand2 CommandMode is invalid	34
0x4007	Warning	ComClient 0x07 - VmuCommand2 OperationalMode is invalid	34
0x4008	Warning	ComClient 0x08 - VmuCommand1 OperationRequest is invalid	34
0x4009	Warning	ComClient 0x09 - VmuCommand1 MinBatteryVoltage voltage is out of range	34
0x400A	Warning	ComClient 0x0A - VmuCommand1 MaxBatteryVoltage voltage is out of range	34
0x400B	Warning	ComClient 0x0B - VmuCommand1 MaxDischargeCurrent is out of range	34
0x400C	Warning	ComClient 0x0C - VmuCommand1 MaxChargeCurrent is out of range	34
0x400D	Warning	ComClient 0x0D - Safety check, delta too high between CommandMode	34
0x400E	Warning	ComClient 0x0E - Safety check, delta too high between SpeedCommand	34
0x400F	Warning	ComClient 0x0F - Safety check, delta too high between TorqueCommand	34
0x4010	Warning	ComClient 0x10 - The library cannot decode the received data	34
0x4011	Warning	ComClient 0x11 - A message received had the wrong DLC	34
0x4013	Warning	ComClient 0x13 - VmuCommand1 timeout	35
0x4014	Warning	ComClient 0x14 - VmuCommand2 timeout	35
0x4015	Warning	ComClient 0x15 - VmuCommandSafety timeout	35
0x4209	Warning	NvdBlackboxSection #10	02
0x4703	Error	GDMGR 0x03 - CAN communication error	35
0x4801	Error	(Position sensor error: verify previous warnings)	05
0x4B00	Warning	CoilTempSensorMgr 0x00 - Motor temperature sensor A1 is invalid	05
0x4B01	Warning	CoilTempSensorMgr 0x01 - Motor temperature sensor B1 is invalid	05
0x4B02	Warning	CoilTempSensorMgr 0x02 - Motor temperature sensor C1 is invalid	05
0x4B03	Warning	CoilTempSensorMgr 0x03 - None of the motor temperature sensors is valid	05

SysFile ID	Diagnostic Type	Description	Troubleshooting Tree
0x050B	Error	Sequencer 0x0B – Deactivation failed. This vent indicates that the deactivation process couldn't be successfully executed.	36
0x050C	Error	Sequencer 0x0C – Deactivation timed out. This event indicates that a timeout occurred while going in the deactivation process.	36
0x0506	Error	Sequencer 0x06 – Motor control in wrong state.	37
0x0507	Error	Sequencer 0x07 – Activation failed.	37
0x0508	Error	Sequencer 0x08 – Activation timed out.	37
0x0509	Error	Sequencer 0x09 – Motor control in wrong state.	37
0x050A	Error	Sequencer 0x0A – Motor control in wrong state.	37
0x050D	Error	Sequencer 0x0D – System error.	37

Appendix 2: Table of Troubleshooting Trees

The following table of the SysFile ID gives the in formation of the diagnostic type, the code description and the related Troubleshooting Tree.

Troubleshooting Tree	SysFile IDs	Causes (numbered in order of likely occurrence)
01	0x0000	**1.** Wrong shutdown sequence. Auxiliary vehicle battery (Vaux) (12V or 24V) powered OFF before the MCU “Ready To Power OFF” CAN status on a shutdown sequence. **2.** Defective MCU.
02	0x000A 0x1300 0x4209	**1.** Wrong shutdown sequence. Auxiliary vehicle battery (Vaux) (12V or 24V) powered OFF before the MCU “Ready To Power OFF” CAN status on a shutdown sequence. **2.** Defective MCU.
03	0x0313	**1.** DCDC not regulating auxiliary DC voltage correctly. **2.** High auxiliary load being activated causing voltage drop. **3.** The auxiliary vehicle battery does not operate correctly. **4.** Intermittent or bad Vaux connection at the MCU. **5.** Vaux Fuse about to open or more resistive. **6.** Defective MCU.
04	0x0314	**1.** DCDC system not regulating auxiliary DC voltage correctly. **2.** Intermittent contact to the auxiliary vehicle battery that can cause voltage spikes due to load dump of the DCDC system. **3.** The auxiliary vehicle battery is not working properly. **4.** The MCU is defective.

Troubleshooting Tree	SysFile IDs	Causes (numbered in order of likely occurrence)
05	0x0315 0x0316 0x0321 0x0322 0x0323 0x0324 0x0325 0x0326 0x2200 0x3109 0x3400 0x3401 0x3402 0x3403 0x3404 0x3406 0x3407 0x3408 0x3500 0x4801 0x4B00 0x4B01 0X4B02 0x4B03	**1.** Some foreign material within the MCU or motor connector short some signals. **2.** MCU or motor connector pin is bent or broken. **3.** Motor sensor cable defective. **4.** Defective motor. **5.** Defective MCU.
06	0x0319	**1.** 0x3113 error occurred at the same time that may lead to a defective MCU **2.** 0x050B error occurred at the same time that may lead to an error at the VCU/ECU level. **3.** Another SysFile occurred at the same time. **4.** Defective MCU
07	0x031A 0x031B 0x031C	**1.** If the 0x0313 SysFile occurred the same time this can be the main cause. **2.** Defective DCDC system. **3.** Defective auxiliary batteries. **4.** Defective MCU.
08	0x031D	**1.** MCU HVIL parameters were not correctly configured. **2.** Another system opens the HVIL loop from the HVIL input of the MCU. **3.** Defective VMU/MCU interface connector on the MCU. **4.** Defective MCU.
09	0x031E	**1.** MCU HVIL parameters were not correctly configured. **2.** Another system opens the HVIL loop from the HVIL input of the MCU. **3.** Defective VMU/MCU interface connector on the MCU. **4.** Defective MCU

Troubleshooting Tree	SysFile IDs	Causes (numbered in order of likely occurrence)
10	0x031F	**1.** MCU HVIL parameters were not properly configured. **2.** MCU phase cables not inserted properly with locking screws installed. **3.** Motor phase cables not inserted properly with locking screws installed. **4.** DC input cables not inserted properly with locking screws installed. **5.** Motor sensor cable not properly inserted properly. **6.** Defective motor sensor cable. **7.** Defective motor. **8.** Defective MCU.
11	0x0320	**1.** MCU HVIL parameters were not properly configured. **2.** HVIL power source fault. **3.** Defective MCU.
12	0x0504	**1.** Wrong motor type connected to the MCU. **2.** Wrong software flashed to the MCU. **3.** Defective MCU (Potential wrong factory settings).
13	0x120A 0x3212	**1.** Third party motor not calibrated. **2.** Defective motor.
14	0x3307 0x2209	**1.** Wrong motor type connected to the MCU. **2.** Wrong software flashed to the MCU. **3.** Defective Motor
15	0x1000 0x1100 0x1200	**1.** Defective MCU.
16	0x1003 0x3301	**1.** Wrong software flashed to the MCU unit (not compatible with MCU P/N). **2.** Wrong MCU P/N unit used with flashed software. **3.** Defective MCU (Potential wrong factory setting).
17	0x3100 0x3101 0x3102 0x3103 0x3104 0x3105 0x3106	**1.** Minor issue. Could potentially be raised due to internal noise under high DC input voltage level. **2.** Defective MCU, if 0x320D SysFile ID also occurs within the same power up. **3.** Defective MCU, if 0x3200 to 0x3208 SysFile ID also occurs within the same power up.

Troubleshooting Tree	SysFile IDs	Causes (numbered in order of likely occurrence)
	0x3107 0x3108	
18	0x310A	**1.** DC high power contactor issue. **2.** DC high power battery source issue. **3.** DC high power battery chain connection issue (contactor, PDU, pre-charge circuit and MCU, BMS). **4.** Improper grounding (MCU and / or motor). **5.** DC system load activation/deactivation. **6.** Defective controller. **7.** Defective MCU.
19	0x310B 0x310C	**1.** “BlackBox info available” is not displayed in the status bar at the bottom of the window in TM4 ODIN tool **2.** Significant voltage drops meaning numerous repeated connections and reconnections. **3.** Affected motor resolver signal (motor angle waveform) that creates DC high voltage ripple. **4.** Continuity fault between the MCU grounding port and the ground. **5.** Another external root causes. **6.** Defective MCU.
20	0x310D 0x310E	**1.** Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit. **5.** Phase cable are damaged. **6.** Wrong torque applied to one or many phase lugs. **7.** Wrong phase cable crimping. **8.** Defective MCU.
21	0x310F 0x3110	**1.** . Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high. **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit. **5.** Defective MCU.
22	0x3112	**1.** Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high. **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit). **5.** Wrong torque applied to one or both DC lugs. **6.** Wrong DC cable crimping. **7.** Defective MCU.
23	0x320F	**1.** Another SysFile occurred (TT05) **2.** Air in the cooling circuit. **3.** Cooling liquid flow too low or nil (cooling pump issue). **4.** Cooling liquid temperature too high **5.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit). **6.** Active short circuit mechanism activated (for more than 2 minutes without speed reduction under safe back EMF voltage). **7.** Defective motor.

Troubleshooting Tree	SysFile IDs	Causes (numbered in order of likely occurrence)
24	0x3405	**1.** Air in the cooling circuit. **2.** Cooling liquid flow too low or nil (cooling pump issue). **3.** Cooling liquid temperature too high. **4.** Wrong cooling agent mixture used – (can create dust/rust in the cooling circuit. **5.** Defective MCU .
25	0x3111 0x4000	**1.** Software problem. Update inverter software. **2.** Defective MCU
26	0x3113	**1.** Other error causes the system to move in defective while in high speed (back EMF too high to maintain DC bus under the high voltage limit).
27	0x3200 0x3201 0x3202 0x3204 0x3205 0x3206 0x3208 0x3209 0x320A	**1.** Short circuit between phases. **2.** The auxiliary vehicle battery not operating correctly. **3.** Intermittent or bad Vaux connection at the MCU. **4.** Vaux Fuse about to open or more resistive. **5.** An external error was caused by VMU/ECU. **6.** Defective MCU.
28	0x3203 0x3207 0x320B	**1.** The auxiliary vehicle battery not operating correctly. **2.** Intermittent or bad Vaux connection at the MCU. **3.** Vaux Fuse about to open or more resistive. **4.** Defective MCU.
29	0x320C	**1.** MCU temperature too high for the motor speed (verify cooling). **2.** Motor temperature too high for the motor speed (verify cooling). **3.** Defective MCU. **4.** Defective motor.
30	0x320D	**1.** Phase cable lugs not properly assembled on inverter or motor. **2.** Wrong phase cables order. **3.** Motor resolver signal incoherence (intermittence signal, distorted signal). **4.** Defective MCU
31	0x320E	**1.** Another system on the same DC bus had a sudden loss of insulation **2.** Outdate software. **3.** Damaged phase cables. **4.** Defective connector causing the short circuit. **5.** Defective MCU. **6.** Defective motor.

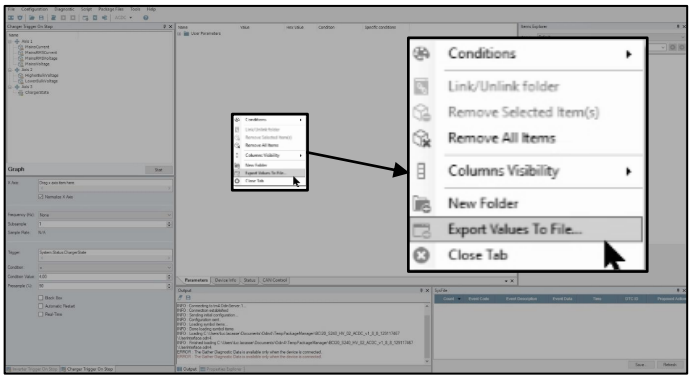
Troubleshooting Tree	SysFile IDs	Causes (numbered in order of likely occurrence)
32	0x3210 0x3211	**1.** Motor speed is too high - Torque derated but something else preventing the speed to reduce. **2.** MCU speed setting parameters wrongly configured (start, end and speed limit derating in forward or backward direction). **3.** Defective MCU. **4.** Defective motor resolver.
33	0x3303	**1.** No issue. Warning listed as error if reported at time 0:00:00 after power up. **2.** MCU software error.
34	0x4001 0x4002 0x4003 0x4004 0x4005 0x4006 0x4007 0x4008 0x4009 0x400A 0x400B 0x400C 0x400D 0x400E 0x400F 0x4010 0x4011	**1.** Verify MCU CAN protocol document for protocol requirements.
35	0x4013 0x4014 0x4015 0x4703	**1.** Verify MCU CAN protocol document for protocol requirements (controller issue). **2.** Defective CAN connection (Cable or harness). **3.** Defective CAN network. **4.** Defective MCU.
36	0x050B 0x050C	**1.** The VMU/ECU has sent a shutdown request to the MCU during operation, causing this error to be raised. **2.** Defective MCU.
37	0x0506 0x0507 0x0508 0x0509 0x050A 0x050D	**1.** Some other error caused the SysFile to be raised.

Appendix 3: Save EEPROM Sections

1. Power-on the unit with appropriate Vaux supply
2. Open Odin Server 1 and establish connection to the MCU.
3. Make sure that at the bottom left of the Odin screen, « Device Connected » is displayed in green text.
4. In Odin Server 1, in the « Package Files » dropdown menu, select « Workspaces » and then, « UserInterface.odn4 ».
5. When the workspace has finished loading, in the watch window, select the « Parameters » tab. Then click the (+) at the left of all the subfolders.
6. Change any of the desired parameter(s) by double clicking on its value field and by changing its value. Once the value is changed, select the keyboard enter key or click elsewhere on the ODIN window so the value is written.

   Note: The parameters in the Motor subfolder cannot be changed. They are "read only" by the user.

7. Once all the desired parameters have been changed, change the value field of the « DrvParameters.Save » to 1 and wait until it comes back to 0 by itself.
8. Follow recommended power-off and power-on cycle to ensure that the unit has properly saved All EEPROM sections. The new parameters will take effect in the MCU control only on the next power ON.
9. It is possible to save all the parameters under Drive subfolder in one file that could be used to upload in another MCU. First, delete the Motor subfolder since this cannot be exported and written to another motor. At this point, right-click in the watch window and select « Export Values to File ... ». You are then asked to select the filename and its location. This will save the file with an .odni extension.
10. The .odni file can therefore be imported in another enabled MCU via the Import Values… located within the ODIN File menu. Once imported, select OK at the pop up window.
11. At this point, change the value field of the « DrvParameters.Save » to 1 and wait until it comes back to 0 by itself.
12. Follow recommended power-off and power-on cycle to ensure that the unit has properly saved All EEPROM sections. The new parameters will take effect in the MCU control only on the next power ON



Appendix 4: Retrieve GDD Files and User Parameters

1. Power-on the unit with appropriate Auxiliary Vehicle Battery (Vaux) supply.
2. Open Odin Server 1 and establish connection to the MCU.
3. Make sure that at the bottom left of the Odin screen, « Device Connected » is displayed in green text.
4. In Odin Server 1, in the « Diagnostic » dropdown menu, select « GDD » and then, click the « ... ».

Note: This will allow you to select the location of where the Motor Control Unit GDD (Gathered Diagnostic Data) File will be saved.

Note: If you didn't succeed to retrieve the GDD Files and user parameters, notify to Dana TM4 and continue further down the troubleshooting tree

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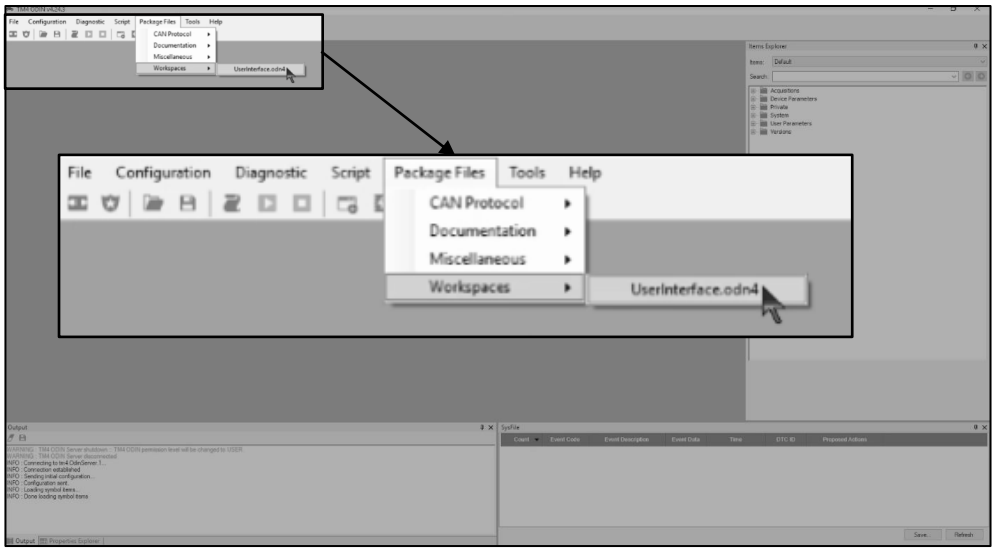
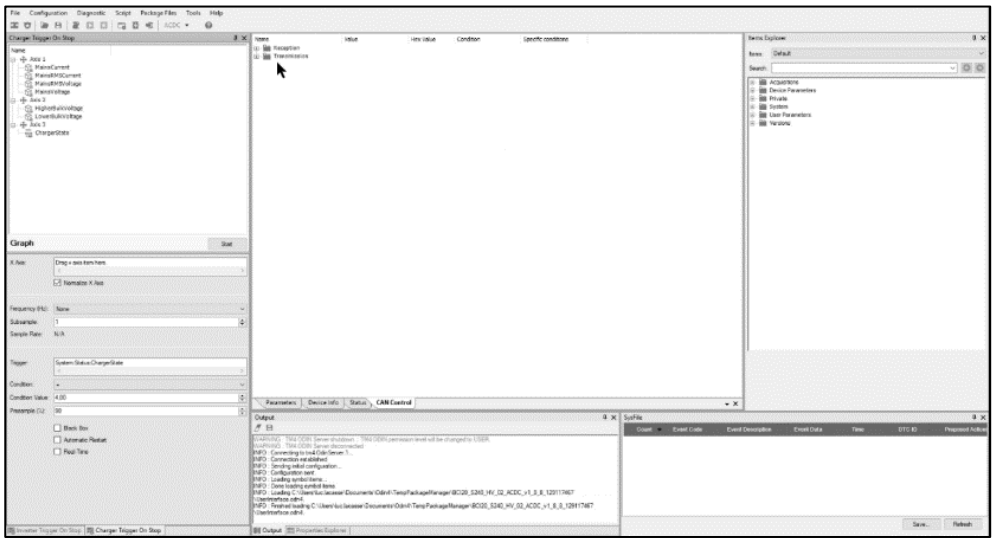
5. Open Odin Server 1 and establish connection to the ACDC controller of the unit.
6. Make sure that at the bottom left of the Odin screen the message, « Device Connected », shows up green.

7. In Odin Server 1, in the « Package Files » dropdown menu, select « Workspaces » and then, « UserInterface.odn4 ».

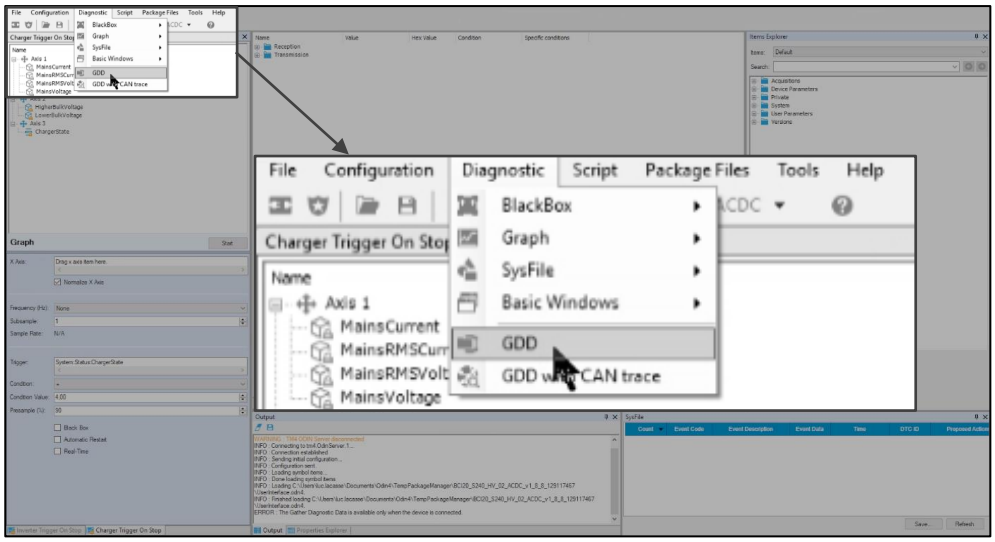


8. Wait until TM4 ODIN load the following page.

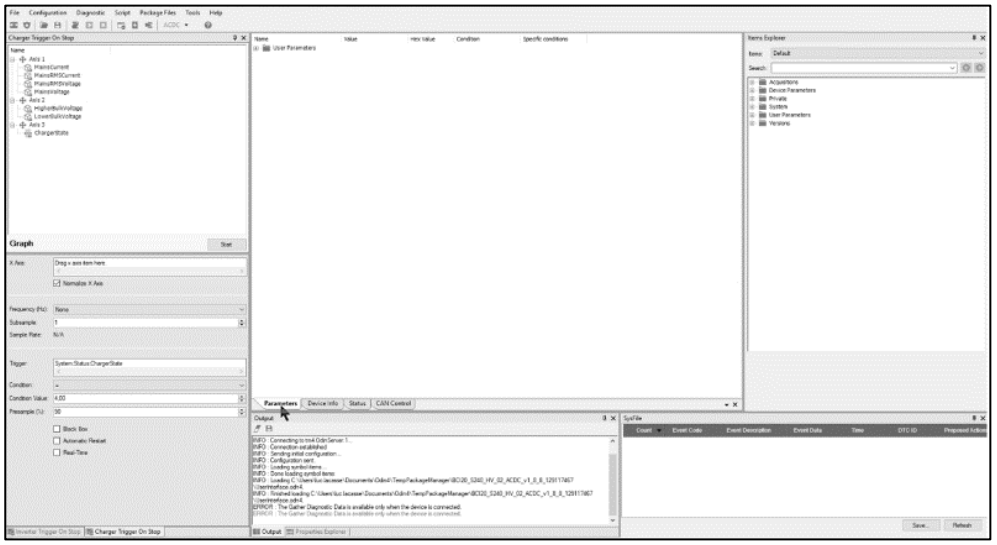


9. Make sure you are connected to the product using TM4 ODIN by checking that the bottom left of the Odin screen, « Device Connected » is displayed in green text.

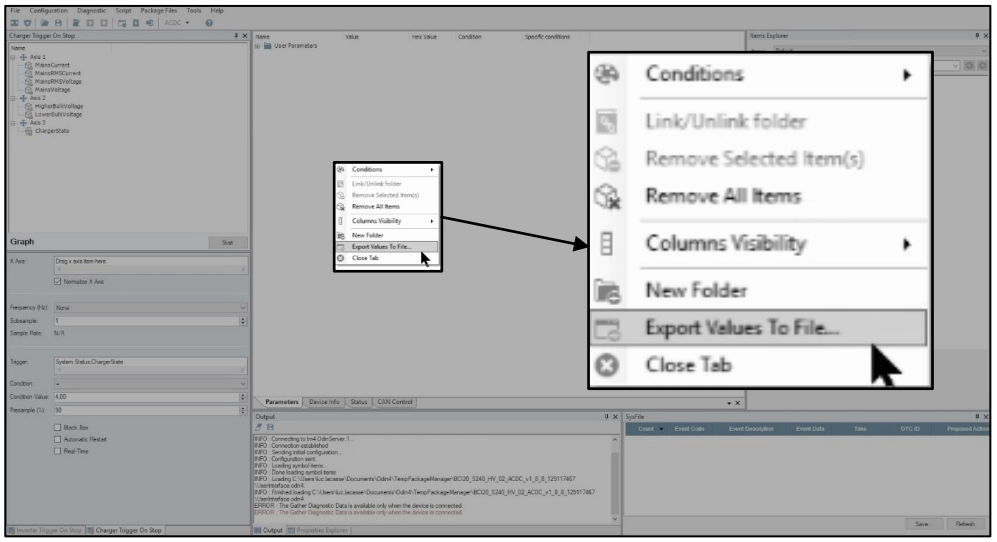
10. In the « Diagnostic » dropdown menu, select « GDD ».



11. Wait until TM4 ODIN load the following page.



12. On the Parameters Tab, right click the select "Export Values To File…".



Appendix 5: Cooling agent precautions

Safety precaution

⚠ WARNING

It is mandatory to proceed with caution when connecting and disconnecting the system.
All precautions should be observed to prevent any infiltration of coolant into the electrical connections.
The electrical property of the coolant will cause electrical malfunction and may cause permanent damages to the unit.
Make sure that the electrical connectors and the coolant connectors are never open at the same time.

Connectors should be capped with adequate protection as soon as possible after they are disconnected.
Connectors should be connected as soon as possible after their protective caps are removed.

Cooling inlet/outlet hoses Safety precautions

⚠ WARNING

Following standard practice safety precautions are mandatory. The unit is connected to chemicals. Knowledge of dangers associated to the specific chemicals used are recommended. The cooling liquid has the potential of being hot and under pressure. Full comprehension of the cooling system is mandatory. Necessary precautions should be observed to avoid injuries.

The cooling agent contains ethylene glycol that is a highly flammable product. Ethylene glycol can burn with an invisible flame that can cause serious burns and/or other injuries.

- Always handle the cooling agent carefully wearing appropriate safety clothing and eyeglasses.

The cooling agent can irritate the skin, the eyes and the mucous membranes.

- Always work in a well-ventilated area when handling the cooling agent; breathing in high concentrations of ethylene glycol can cause nausea.

Safety precaution

In case of contact with eyes and skin, rinse with water and consult a doctor.

- In case of ingestion, seek medical help immediately.

The cooling agent is under pressure when heated; removing the hoses when the coolant is hot can cause serious burns and/or other injuries.

- Wait until the coolant reaches an ambient temperature before removing the cables.

All potential dangers of handling cooling agents cannot be listed here.

- Consult manufacturer warnings and recommendations for safe handling of the cooling agent.

Appendix 6: Update Software

1. Download the up to date software from the Dana TM4 extranet site.
2. Once downloaded, execute the software package exe file. The appropriate file will be saved at the right location on the PC for ODIN usage.
3. Once executed, the original .exe file can be discarded.
4. Start ODIN4 using the ODIN 4 Server 1 shortcut.
5. Make sure that the ignition key is set to **ON** in order to establish communication with the MCU. The « Device Connected » in green text should be shown in the Status bar. If that is the case, go to step 7. Otherwise, continue on the next step.
6. If communication with the MCU was not established, select the **Configuration/Device communication** and select « Find Device » button. Wait until your CAN interface establish communication with the MCU by looking at the window under the « Find Device» button. Once communication is established, select it and then select « Apply » button.
7. Make sure that the ignition key is set to **OFF** and wait until «Device disconnected » in yellow is shown in the ODIN status bar. From a previous power ON, this could take up to 10 seconds maximum.
8. From the TM4 ODIN menu, select **Configuration/Flash program manager**. **Note**: A message is displayed asking if you want to save the current workspace before programming another package; if you want to keep a copy of the workspace, save it as an .odn4 file. If you do not choose to save, the data will be cleared.
9. Select the application software from the **Select program** list.
10. Click **Start**; wait a few seconds until the start button name change to **Stop**.
11. Turn the ignition key to **ON** and wait for the software update to complete.
12. Once completed, TM4 ODIN disconnects from the server and will display a window to confirm the success of the package update.
13. Click the **OK** button to reconnect to the TM4 ODIN server.
14. At this point, the Basic TM4 ODIN file (UserInterface.odn4) can be opened from the ODIN menu **Package Files/ Workspaces**.
15. Contact TM4 Customer Service if you require help programming the system using TM4 ODIN.

Remove electrical connections

Safety precaution

⚠ WARNING

Safety instructions related to electrical removal/installation:

Electrical connections should be handled by fully trained personnel. High voltage, potentially as high as 750V for a HV system may be present and this should be seen as a dangerous and possibly lethal source.

Always follow recommended precautions when handling electrical equipment. The MCU stores electrical energy during operation and may retain it for some time after it is powered-off. It is highly recommended to ensure that the internal energy has dissipated before proceeding with the electrical disconnection of the unit.

ESD sensitive – do not touch connector pins.

- The internal electronics are sensitive to electrostatic discharges.

Risk of electric shock – do not open the product.

- The electrical installation of the system does not require the product to be opened or disassembled.

Risk of electric shock – capacitor stores hazardous energy.

- Wait 10 minutes after disconnecting all electrical power supplies prior to removing cables and/or servicing to ensure that internal product capacitors are discharged.

This product uses common mode capacitors between the high-voltage DC bus and the chassis. Some apparatuses can cause dangerous frame current to pass through these capacitors if they are connected to a high-voltage DC bus.

- Always measure the voltage between the high-voltage DC bus and the chassis using appropriate protection and insulation before manipulating the product.

This product uses differential mode capacitors between the positive high-voltage DC bus (+) and the negative high-voltage DC bus (-). Even when the product is disconnected from the high-voltage source, these capacitors can hold a voltage high enough to cause an electric discharge or death.

- Always measure the voltage between the positive high-voltage DC bus (+) and the negative high-voltage DC bus (-) using appropriate protection and insulation before manipulating the product.

Operations

1. Make sure to read and acknowledge the previous safety instruction before starting the following steps.
2. Disable the high-voltage and auxiliary batteries before disconnecting any cable, harness or hose.
3. Wait 10 minutes after disconnecting all electrical power supplies prior to removing cables and/or servicing to ensure that internal product capacitors are discharged.
4. Note the cables and connectors position for future installation.
5. Remove the coolant connection from the MCU. Use appropriate precautions.
6. Remove the DC connector of the high-voltage battery input of the MCU with precaution.
7. Remove the AC phases connector or connections of the MCU.
8. Remove the motor sensor connector from the MCU communication connector with precaution.
9. Remove the grounding strap with precaution.

Remove the MCU from the vehicle

Safety precaution

Safety instructions related to the charger removal:

⚠WARNING

Follow the vehicle integrator's instructions to unmount the unit. You may be asked to keep the hardware for the reinstallation of the replacement charger.
Chargers are not supplied with mounting hardware.

Care must be taken when handling the unit.

- This product must be handled by qualified and authorized personnel in accordance with applicable vehicle standards and industry practices. Always use appropriate insulation and protection before manipulating the product even when the product is disconnected from a high-voltage source.

Operations

1. Remove the mechanical fixation from the charger.
2. Remove the charger from the vehicle with precaution.

Install the new unit

Safety precaution

⚠WARNING

Mishandling of this product may damage the product and/or cause injury or death.

- Do not attempt to open the charger for repairs; in case of damaged casing or suspected product malfunction, contact TM4.
- If using straps to lift the charger, ensure they do not touch or put pressure on the connectors.

When manipulating this product:

- Do not modify any part.
- Do not apply any external loads.

Operations

1. Make sure to acknowledge all the safety precaution needed to install the unit before handle it.
2. Refer to the integrator installation manual to install the unit according the integrator configuration.

Prepare and pack defective unit for shipping

⚠ CAUTION

This section describes the conditions that must be adhered to transporting TM4 products in order to ensure optimum performance once installed in a vehicle.

On leaving TM4 facilities, the product is void of all coolant and all connectors are covered. The packaging is designed to protect the content against damage from vibrations and impacts and is able to withstand maritime conditions during transportation.

TM4 products must be transported in well-ventilated facilities with adequate protections against dust and excessive humidity.

Note: The replacement unit comes with all necessary caps and protectors. It will arrive in fully equipped transports box.

While the products are in the original shipping crates, there are no precautions to take against electrostatic discharge (ESD); however, when packing/unpacking and manipulating the products, you must avoid touching the connector pins.

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For spec‘ing or service assistance, call 1-877-777-5360 or visit our website at http://www.dana.com

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