WE HAVE MORE THAN 30 YEARS OF EXPERIENCE, DEVELOPING DIRECT CURRENT COMPRESSORS AND HELPING CUSTOMERS BENEFIT FROM THE OPPORTUNITIES OF MOBILE REFRIGERATION TECHNOLOGY.

WITH A DEEP INSIGHT OF THE USAGE ACROSS VARIOUS APPLICATIONS WE HAVE EARNED A POSITION AS MARKET LEADER, WORKING WITH OEM-CUSTOMERS .

CONTROLLER FOR BD1.4F-AUTO COMPRESSORS

SECOP

OPERATING INSTRUCTIONS

101N1010, 12 V DC

TOOL4COOL®
Flexible control settings

1.
TABLE OF CONTENTS

Table of Contents

2. INTRODUCTION

Applications

The BD1.4F-AUTO 12 V DC compressor system has been introduced primarily for use in automotive cooling boxes for luxury cars.
The operating conditions are low and medium back pressure (LBP/MBP).
The system is capable of operating in ambient temperatures up to +55 °C (131 °F).

Secondary applications could be:
- Portable cooling boxes
- Cooling boxes in trucks
- Cooling boxes in marine equipment

Key Functions

The main functions of BD1.4F-AUTO compressor systems are:
- Motor / Compressor speed control
- Thermostat control (ON / OFF or electronic via NTC temperature sensor)
- Input for MMI connection incl. LED's (with Dim function)and switches
- Condenser fan control
- Communication interface
- Monitoring function
- Error & event Log
- Battery protection functions
- Main Switch
- Automotive conform connectors
- Possibility to log specific parameters
- Via PC software, optimize specific parameters before going into mass production
- Parameter setting via PC and resistors

3.
ELECTRICAL HARDWARE KEY-PARAMETERS

Electrical Hardware Key-Parameters

Below you can find a list with the key parameters for the electronic unit 101N01010

Name	Reference /value / Standards
Type code	101N01010
Humidity test passed according to	Static humidity according to IEC 60068-2-3
Damp heat	According to EN60068-2-30 test Db
Maximum Operating temperature	55 °C (70 °C for running communication)
Minimum Operating temperature	-25 °C (-40 °C for running communication)
Storage temperature	- 40 °C to 90 °C
EMC approval/ conformity	According to 2004/104/EC
External fuse required	Max. 10 A Slow blow
Leakage current	50 µA (When wake up signal is OFF)
Condenser Fan output	5 W, nominal voltage 12 V max limited to 14 V
NTC type to be connected	Epcos M800/5K
Input voltage	8.5 – 17 V DC (Nominal voltage 13,8 VDC)
Starting Current	8 A
Current consumption under running conditions	See section 21
LED output	Max. 15 mA

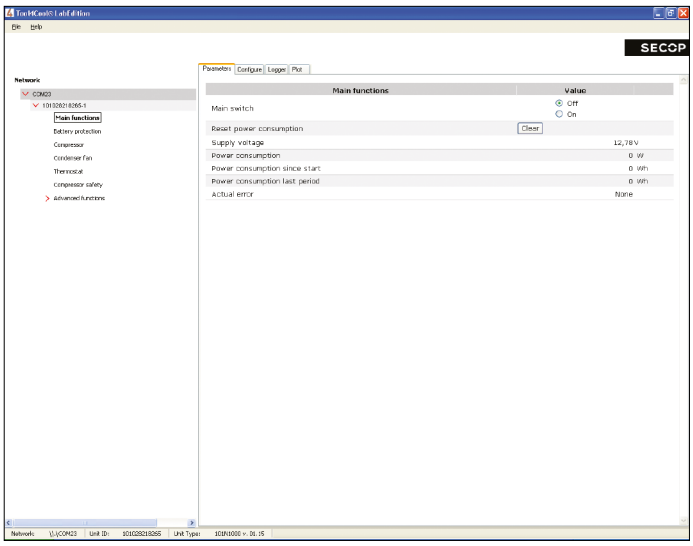
4.
MENU OVERVIEW

Menu Overview

The Compressor control unit must be operated through the Secop PC software TOOL4COOL®. The menu structure is shown below.

Each separate menu is explained in detail on the following pages.

For installation and operation of TOOL4COOL® please refer to the manual which is provided with the software.



5.
MAIN FUNCTIONS

Main Functions

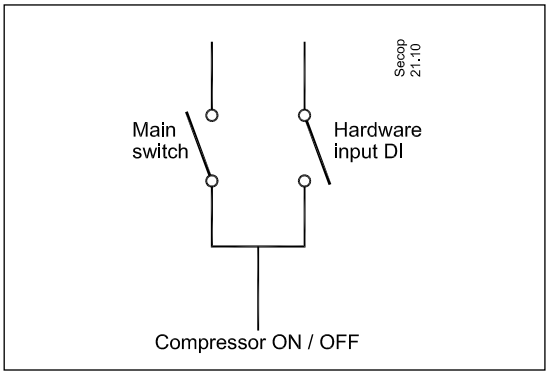
There are two alternatives in which to start and stop the compressor; a hardware input (DI) or the Main Switch in the software. Both of these may be set to ON or OFF position. They are implemented in parallel so they are both able to start and stop the compressor.

OEM´s making interface via Modbus with custom design electronics, can control the CCU ON / OFF via the Main Switch.

ON:
- All functions are active.

OFF:
If no communication (no TOOL4COOL®):
- All functions are inactive.

If communication (TOOL4COOL® or custom made display on the bus):
- Compressor is off
- Possible to make adaptations of parameter
- Reading of parameter
- Possible to turn ON/OFF the condenser fan



Settings

Name	Default	Max value	Min value	Step	Unit
Main Switch	OFF	ON	OFF	1	

6.
POWER CONSUMPTION MONITORING

Power Consumption Monitoring

Compressor power consumption is monitored at 10 minute intervals. The following information is viewed using the TOOL4COOL® interface:

- Compressor power consumption
- Cumulative power consumption since start up
- Cumulative power consumption of the previous period
- The user can reset power consumption to zero using the reset power consumption function

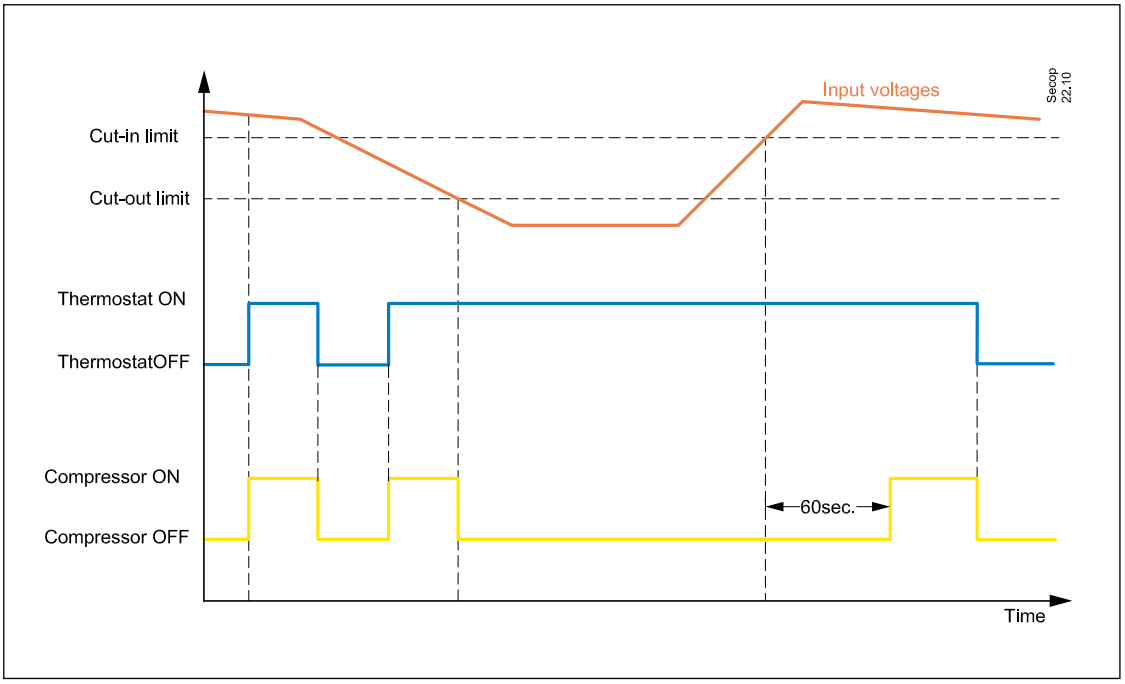
Name	Description	Step	Unit
Power consumption	Actual Power consumption	1	W
Power consumption since start-up	Power consumption since start of power supply	1	Wh
Power consumption last period	Power consumption from the previous power cycle (the consumption in the time where the main switch or the **DI** input as been ON)	1	Wh

7.
BATTERY PROTECTION

Battery Protection

In order to avoid permanent damage to the battery, due to discharge, there must be a battery protection.

The setting range is from 8.5 to 17 V DC.
A critical stop without delay occurs if the voltage drops below 7 V DC or exceeds 17V DC.
Tolerances are ± 0.15 V DC.



Settings

Name	Default	Max value	Min value	Step	Unit
Battery cut out level	8.5	17	8.5	0.1	Volt
Battery cut in diff.	0.5	8	0.5	0.1	Volt
Cut out delay	3	60	0	1	Seconds

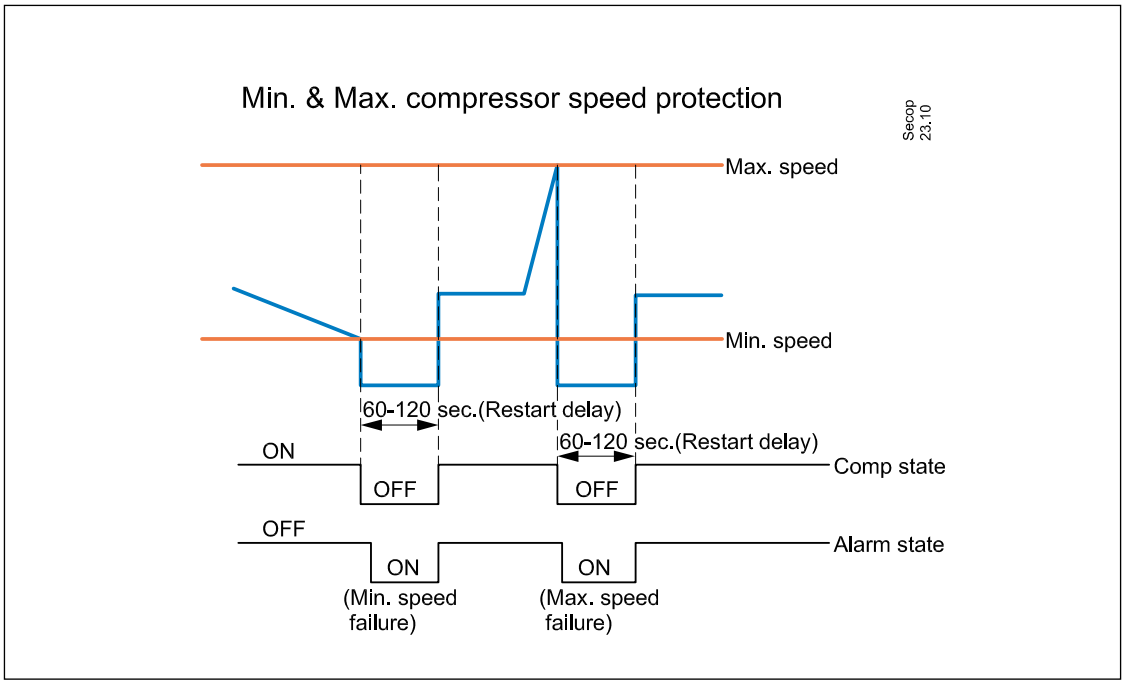
Measurements

Name	Description	Step	Unit
Cut in level	Calculated value. Cut in = Cut out + Diff	0.1	Volt
Supply voltage	Actual voltage measured on + & - terminals	0.1	Volt

8. COMPRESSOR

Compressor Measurements

The speed of the compressor is fixed at 3000 rpm. As a result of different pressures in the system, the speed may deviate. The compressor is protected against operating below the minimum speed. If the compressor falls below the minimum or exceeds the maximum speed the compressor must be stopped and an alarm reading 'Minimum speed failure or Maximum speed failure' will be sent. The compressor will try to restart after the preset Restart time. Default = 60 sec.
The condenser fan will continue to run.

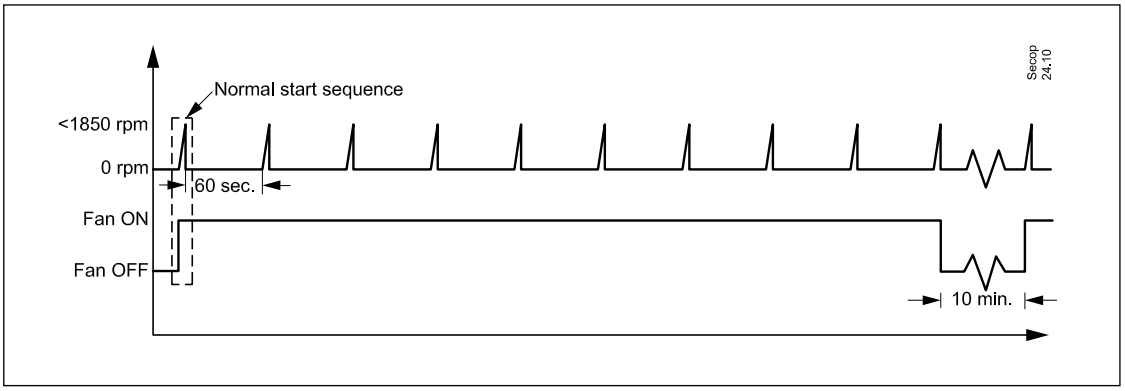


Measurements

Name	Description	Step	Unit
Compressor speed	Actual speed (+/-10%)	1	rpm

9.
OPTIMIZED START-UP SEQUENCE

Optimized start-up sequence



In an optimized start up sequence, the condenser fan will continue to run until a successful start has been achieved, or until the CCU has tried to start 10 times.
After ten failed start attempts, 10 minutes will pass and the compressor will perform another 'single' start attempt. After 6 repeats of these single start attempts with a 10 minute break, the compressor will not start again, until the power supply has been disconnected then switched back on.

10. CONDENSER FAN

Condenser fan

The condenser fan is synchronized with the compressor operation, in particular providing the option to set start and stop delays in relation to the thermostat status.
Furthermore, it is possible to continuously run the condenser fan (forced ON operation).
It is possible to detect some condenser fan defects.

Settings

Name	Default	Max value	Min value	Step	Unit
Fan start delay	0	240	0	1	Seconds
Fan stop delay	0	240	0	1	Seconds
Fan forced ON	OFF	ON	OFF	1	
Detect missing fan	OFF	ON	OFF	1	

Measurement

Name	Description	Step	Unit
Fan speed	Actual fan speed	0/100	%

11. THERMOSTAT

11.1 Hardware set up

If choosing hardware set up, it is only possible to mount a mechanical thermostat. The battery cut in and cut out values can be set with resistors.

Battery protection resistors must be mounted between S2 and C and a 316 ohm resistor must be mounted between S1 and C, in series with the thermostat, which indicates you will programme the setting with resistors.
The compressor cuts in and out whether the mechanical thermostat is open or closed.
For further information also see the wiring diagram.

11.2 Software set up

Thermostat type

Auto
It is possible to connect a mechanical thermostat or a NTC sensor.
Auto setting is default.
Battery protection settings are default values from TOOL4COOL® and may be changed through the software.
When using the NTC 1 sensor the compressor cuts in and out through the set point chosen in TOOL4COOL®.

NTC (NTC 1)
An NTC sensor must be connected. If there is no NTC connected the unit will show a failure.
The compressor cuts in and out through the set point chosen in TOOL4COOL®.

Mechanical
The unit senses the mechanical thermostat and reacts with an ON and OFF signal. The battery protection setting can be set via TOOL4COOL®.

Auxiliary temperature (NTC2)

If there is a need to measure the ambient temperature, it is possible to mount a NTC in sequence with a 4.7 kohm resistor, between the terminal **S2** and **C**.
When the NTC is connected, the sensor creates two additional functions.
It protects the system from overheating; when the ambient temperature is above 55 °C the compressor will stop.
Secondly, when performing the self test (see section16), the sensor ensures that the ambient temperature is no higher than 30 °C.

Operating state only applicable for NTC sensor

Fridge mode / freezer mode (NTC 1)
When running on NTC sensor, two temperature set points are possible in TOOL4COOL®, which are then connected to the NTC sensor and can be selected with two push buttons.

1. By default, the unit will run on the fridge set point.
The set point can be changed via TOOL4COOL® or when the push button is connected to the MMI interface. When the push button is pressed once, the system will begin to operate with the set point and a corresponding LED will light up (if connected). When the push button is pressed a second time, the system will stop.
The set points can be changed by pushing the other push button.

Forced on
With TOOL4COOL®, the system may be set to a forced mode. This creates a constant cooling demand, independent of the set points or the sensor connected to S1 and C.

Settings

Name	Default	Max value	Min value	Step	Unit
Thermostat type	Auto	Electronic			
Cut out temperature fridge	10	40	-40	1	Celsius (°C)
Difference fridge	2	15	1	1	Kelvin (K)
Cut out temperature freezer	-4	40	-40	1	Kelvin (K)
Difference freezer	2 | 2	15	1		Celsius (°C)
Operating state	Fridge				Kelvin (K)

Measurements

Name	Description	Step	Unit
Runtime	Runtime is provided to record the cooling-time (thermostat cut-in period). The runtime is updated during cooling, starting with 0 at start of cooling. During cooling OFF (Thermostat cut-out), the Runtime will show the time from the previous cooling period. Runtime is reset at cooling ON period. At power-up the reading is reset.	1	Minutes
Actual temperature	Actual air temperature when a NTC 1 sensor is used. At mechanical thermostat, an ON or OFF status is shown		Celsius (°C)
Actual cut in temperature fridge	Cut out temperature fridge+ Difference fridge		Celsius (°C)
Actual cut in temperature freezer	Cut out temperature freezer+ Difference freezer		Celsius (°C)
Auxiliary temperature	Temperature measured by second NTC 2		Celsius (°C)

12.
COMPRESSOR SAFETY

Compressor safety

In order to prevent the compressor from short circuiting, a minimum restart time is introduced.
After timeout of Compressor restart time a new start of the compressor is permitted.

Settings

Name	Default	Max value	Min value	Step	Unit
Compressor restart time	60	120	60	1	Seconds

13. COMMUNICATION

Lost communication

In a network system with custom designed interface modules acting as the master on the Modbus, it is not desirable to let the compressor run after communication to the master has been lost.
If communication is lost it will not be possible for the customer to stop the compressor, as long as cooling is requested.
When there is no contact to the master controller (Communication time out), after a certain time the compressor will stop. The stop is acknowledged by the Main Switch. The Main Switch will be set to OFF and will remain OFF until the master controller sets it back to ON via Modbus.

Protection of settings

In order for customers to protect settings from being read out by others, a protection function is available. The code must be verified by entering it twice.

Settings

Name	Default	Max value	Min value	Step	Unit
Node number	1	247	1	1	
Bits per second	19200	9600	19200	9600	bps
Set main switch to OFF when communication timeout occurs	900	15	7200	1	Seconds
Communications timeout	900	15	7200	1	Seconds
Setting protection code and status	0	9999	0	1	

14.
PRODUCT INFORMATION

Settings

Name	Description
Unit name	Possible to fill in customer name for the unit when presented in PC software programme TOOL4COOL®
Vendor name	
Product code no	
Software version	
Unit ID	
Production date	
Lot no	
Serial no	

15.
CUSTOMER REGISTER

Customer register

A customer register makes it possible to change and set values in custom designed interface modules.
Change and interaction will be via TOOL4COOL®.
The parameters are visible even when in protection mode.
Contact Secop for further information.

Settings

Name	Default	Max value	Min value	Step	Unit
Register 1 to Register 10	65535 65535	65535 65535	0 0	1 1	

16.
SELF TEST / DIAGNOSTIC

Self test / diagnostic

The self test is a function of the BD1.4F-AUTO electronic, which indicates if the entire box is working properly.
The idea is it to get a fixed delta in temperature during a fixed time period.
Both the time period and the delta in temperature are flexible.
The temperature in the box is measured before the compressor starts with NTC1. Then the compressor starts and runs for the fixed time period. The compressor stops and the box temperature is measured again NTC1 and compared to the start temperature, determining if the box has cooled sufficiently.

To avoid interference on the test due to high ambient temperature, the ambient temperature is also measured with NTC2 before the start of the test. The maximum limit for the ambient temperature is fixed at 30 °C.

The self test will begin when both push buttons are pushed at the same time for 3 seconds or using TOOL4COOL®.
The self test may be cancelled at anytime by pressing both push buttons. When nothing is pushed it will disappear 6 min after the test has finished.

The status of the Self diagnostic is shown on the LED´s of the MMI
0.5 Hz both LED´s Performing self test
Both LED´s fully ON status ok
5 Hz both LED´s flashing status not ok
5 Hz left LED flashing supply voltage not ok
5 Hz right LED flashing ambient temperature not ok

Settings

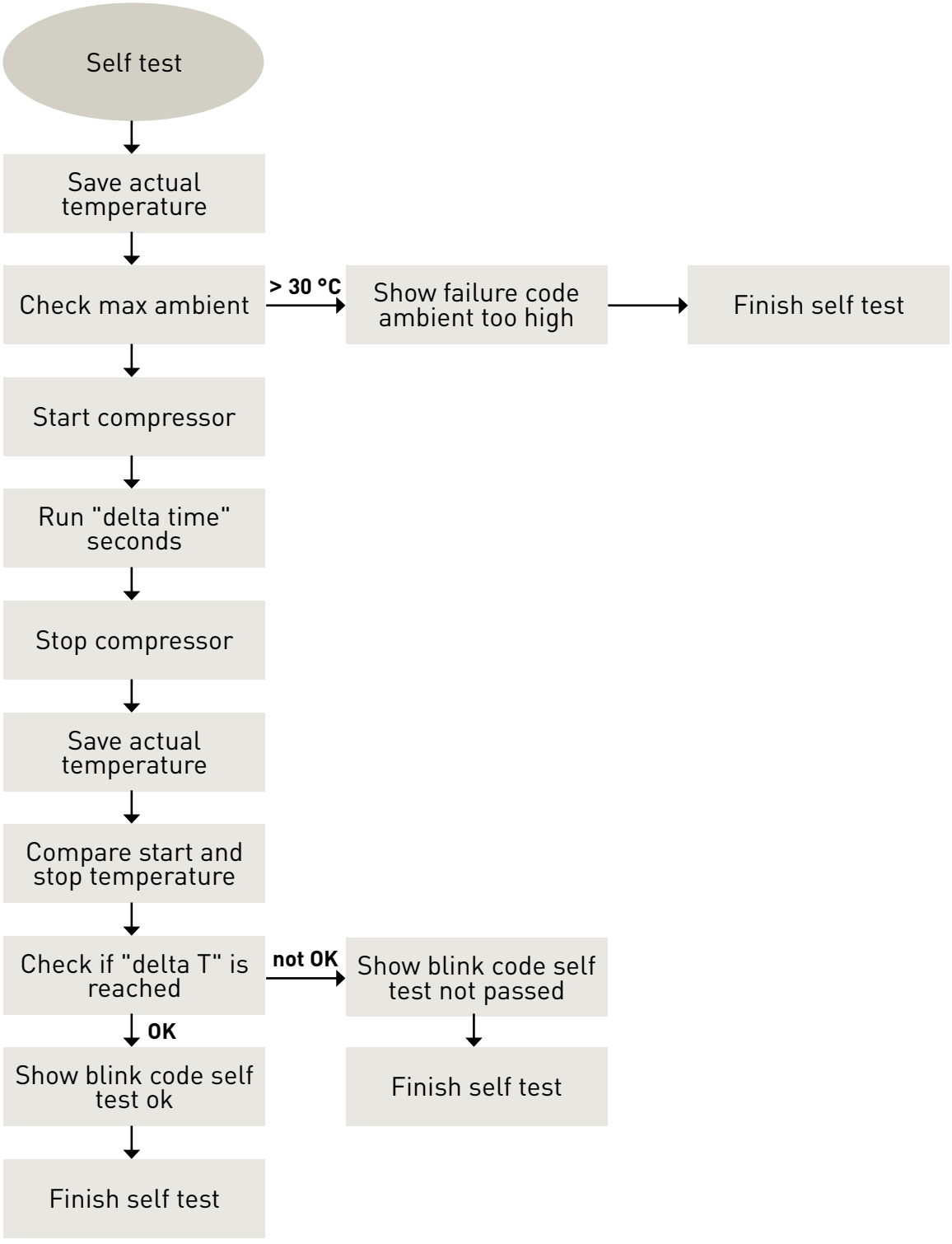
Name	Default	Max value	Min value	Step	Unit
Time to reach the delta temperature	300	1200	10	1	s
Delta temperature for self diagnostic	5	30	1	1	Kelvin (K)
Start self diagnostic	0	1	0	1	

Measurements

Name	Description	Step	Unit
Result diagnostic	Outcome of self test		

17.
FLOW CHART FOR SELF TEST

Flow chart for selftest



18.
ERRORS IN TOOL4COOL®

Errors in TOOL4COOL®

The purpose of the alarm function is to notify the user when there is an error in the system and takes measures to prevent any damage in the refrigeration system.

Measurements

Name	Description	Step	Unit
Actual error	0= No error 1=Battery protection failure 2=fan failure 3=Motor failure 4= Min. speed failure 5=Thermal failure 6=NTC failure 7=Communication Error		

19. ELECTRONIC UNIT OVERHEATING PROTECTION

Electronic unit overheating protection

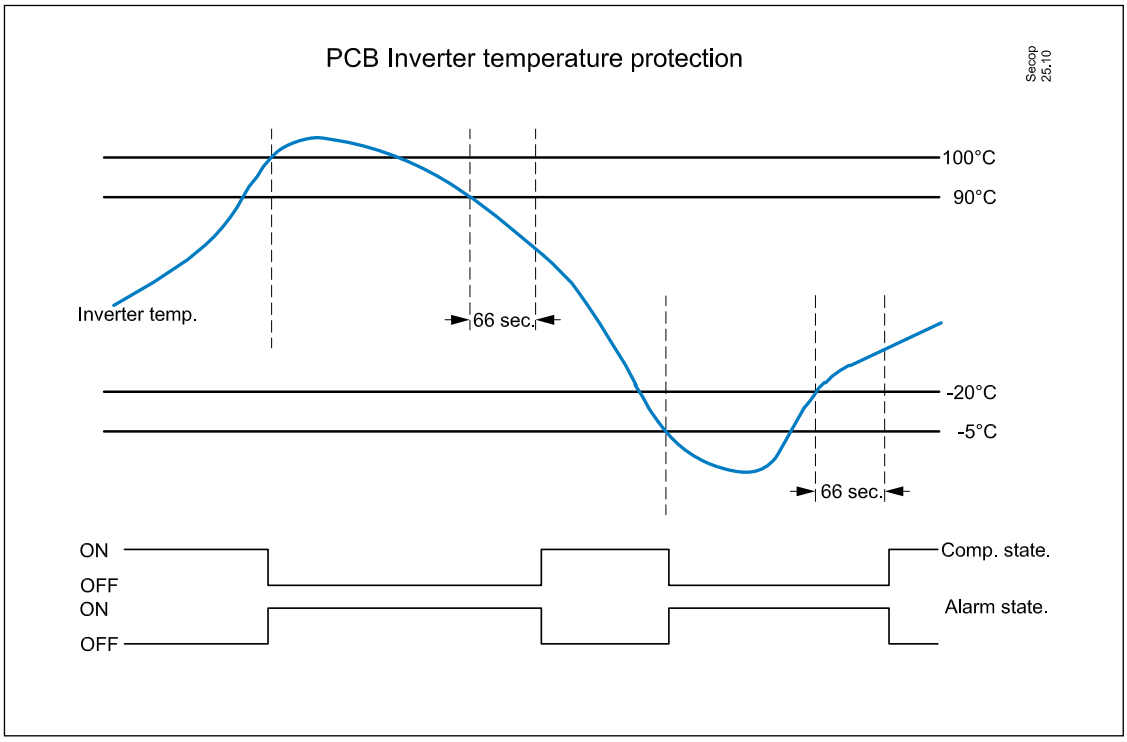
The purpose of the alarm function is to notify the user when there is an error in the system to take measures to prevent any damage in the refrigeration system.

20. ELECTRONIC UNIT UNDER TEMPERATURE

Electronic unit under temperature

The protection system ensures that the electronic unit will not be damaged at extreme operating temperatures. When the unit reaches -10ºC on PCB the system will shut down and an alarm error (Thermal failure) will be sent.

The system automatically starts when the temperature rises above -5 ºC. After this, the set delay 'Compressor restart delay' must be terminated. Default 60 sec.



21.
TECHNICAL DATA BD1.4F-AUTO COMPRESSOR

General

Code number (without electronic unit)		109Z0102
Electronic unit 12 V		single: 101N1010
Compressors on pallet		180

Application

Application		LBP/MBP
Evaporating temperature	°C	-25 to 5
Voltage range		9-17 V DC
Max. condensing temperature continuous (short)	°C	60 (70)
Max. winding temperature continuous (short)	°C	125 (135)

Cooling requirements

Application	LBP	MBP	HBP
32°C	S	S	–
38°C	S	S	–
43°C	S	S	–
Remarks on application:			

Motor

Motor type		permanet magnet, brushless DC
Resistance, all 3 windings (25°C)	mΩ	50

Design

Displacement	cm^3	1.41
Oil quantity (type)	cm^3	75 (polyolester)
Maximum refrigerant charge	g	150
Free gas volume in compressor	cm^3	500
Weight - compressor/electronic unit	kg	2.1/0.17

22.
CAPACITY TABLES BD1.4F-AUTO COMPRESSOR

Capacity tables BD1.4F-AUTO compressor

EN 12900 Household (CECOMAF)

Evap. temp. in °C	-25	-23.3	-20	-15	-10	-6.7	-5	0	5
Capacity in W	14.3	17.5	24.3	36.1	50.0	60.5	66.4	85.5	108
Power cons. in W	26.1	27.5	30.3	35.0	40.0	43.4	45.2	50.4	55.6
Current cons. in A	1.98	2.08	2.30	2.65	3.03	3.29	3.42	3.82	4.21
COP in W/W	0.55	0.64	0.80	1.03	1.25	1.39	1.47	1.70	1.94

EN 12900 Household (CECOMAF)

Evap. temp. in °F	-13	-10	0	10	14	20	30	40	41
Capacity in W	14.3	17.5	29.3	43.6	50.0	60.6	81.0	105	108
Power cons. in W	26.1	27.5	32.3	37.7	40.0	43.4	49.3	55.0	55.6
Current cons. in A	1.98	2.08	2.45	2.86	3.03	3.29	3.73	4.17	4.21
COP in W/W	0.55	0.64	0.91	1.15	1.25	1.40	1.64	1.91	1.94

ASHRAE LBP

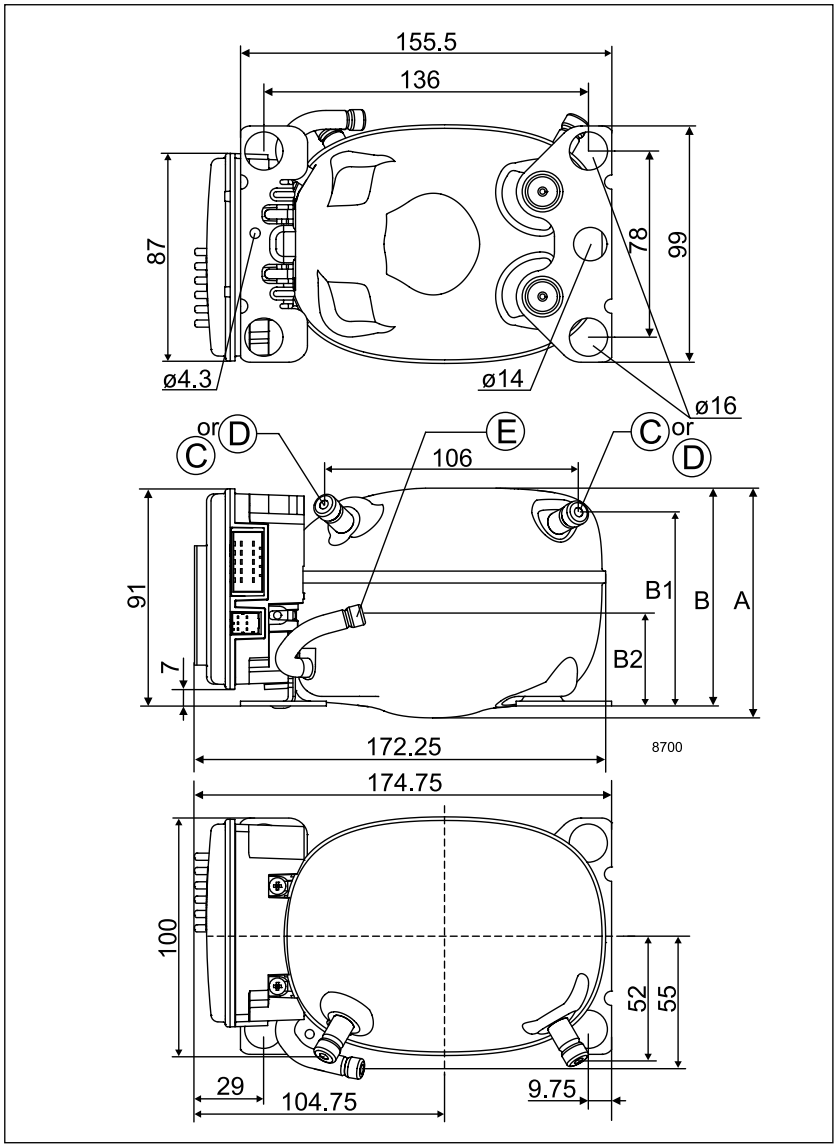
Evap. temp. in °F	-13	-10	0	10	14	20	30	40	41
Capacity in BTU/h	61.8	75.1	125	185	212	257	344	446	457
Power cons. in W	26.2	27.5	32.3	37.7	39.9	43.4	49.1	54.8	55.3
Current cons. in A	1.98	2.08	2.45	2.86	3.03	3.28	3.72	4.15	4.19
ERR in BTU/h	2.36	2.73	3.86	4.91	5.32	5.94	7.00	8.15	8.27

ASHRAE LBP

Evap. temp. in °C	-25	-23.3	-20	-15	-10	-6.7	-5	0	5
Capacity in W	18.1	22.1	30.5	45.0	62.3	75.3	82.6	106	134
Power cons. in W	26.2	27.5	30.3	35.0	39.9	43.3	45.1	50.3	55.3
Current cons. in A	1.98	2.08	2.30	2.65	3.03	3.28	3.42	3.81	4.19
COP in W/W	0.69	0.80	1.00	1.29	1.56	1.74	1.83	2.12	2.43

Test conditions	EN 12900/CECOMAF	ASHRAE LBP
Condensing temperature	55°C	54.4°C
Ambient temperature	32°C	32°C
Suction gas temperature	32°C	32°C
Liquid temperature	no subcooling	32°C
Capacity and power consumption tolerance +/-10% at rating point -10/55°C		

23.
DIMENSIONS

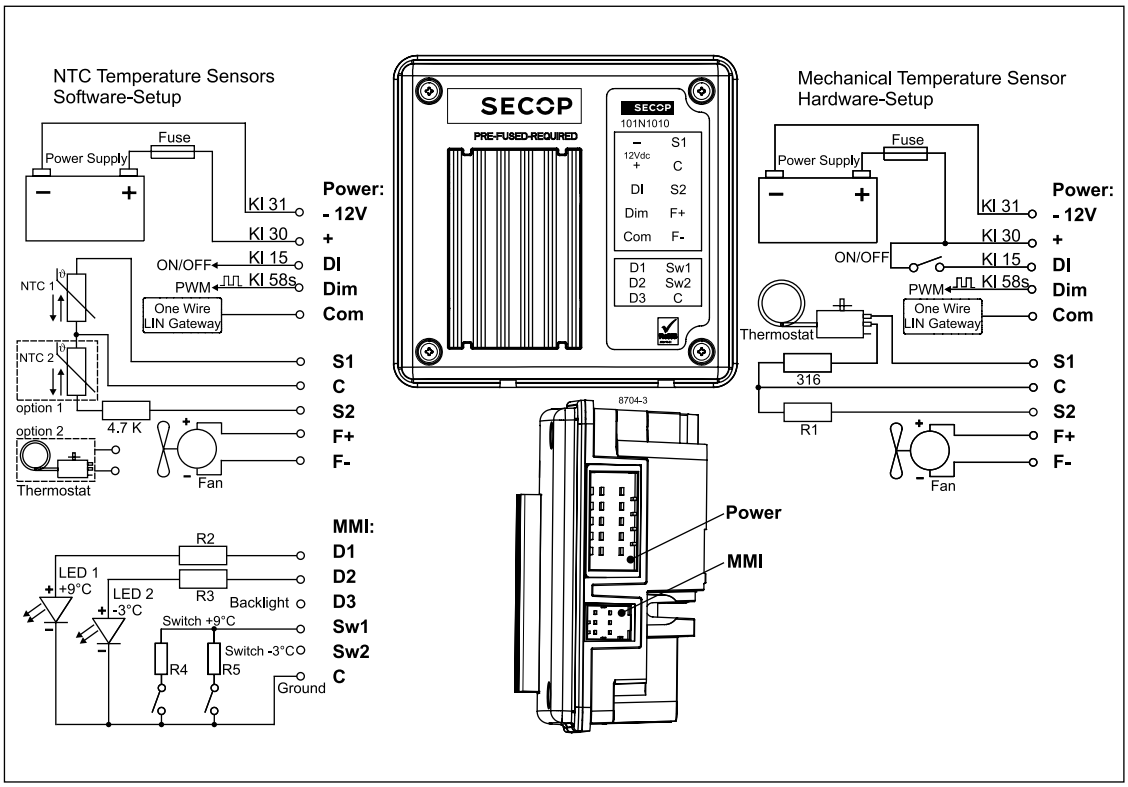


Dimensions

Height	mm	A	96.25
		B	91.25
		B1	87.70
		B2	38.50
Suction connector	location/I.D. mm | angle	C	6.2 | 15°
	material | comment		Cu-plated steel | Al cap
Process connector	location/I.D. mm | angle	D	6.2 | 25°
	material | comment		Cu-plated steel | Al cap
Discharge connector	location/I.D. mm | angle	E	5.0 | 15°
	material | comment		Cu-plated steel | Al cap
Connector tolerance	I.D. mm		±0.09, on 5.0 +0.12/+0.20
Remarks			

24.
WIRING

Wiring



Resistors

Marking	Value [Ω]	Function
R1	see page 27	battery protection
R2	750	resistor LED 1
R3	750	resistor LED 2
R4	1500	coding resistor S1
R5	330	coding resistor S2

Connectors (Tyco Electronics)

Code no	Male	Female	Crimp
Power	178305-5	178289-5	1-175218-20
MMI	1376136-1	1-1318119-3	1-318108-1

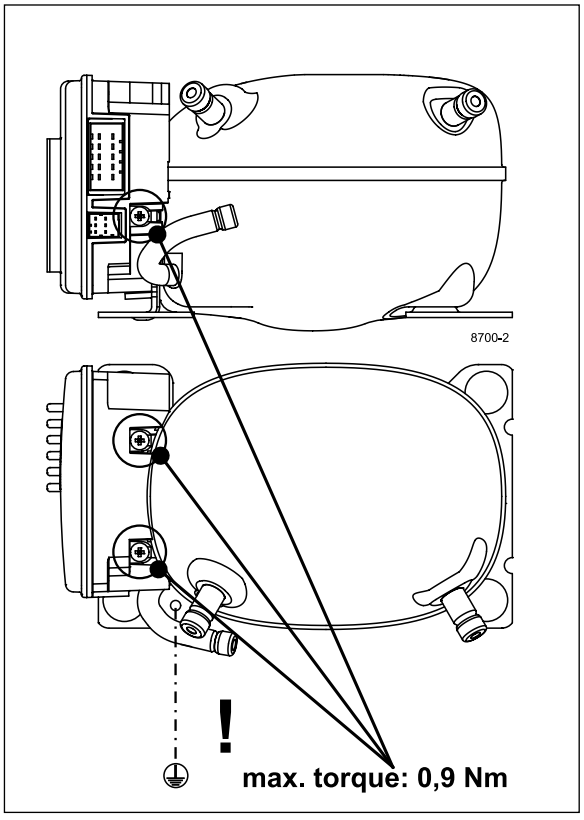
25.
INSTRUCTIONS

Standard battery protection settings

12 V cut-out [V]	12 V cut-in [V]
8.5	9.0

Optional battery protections setting (calculated)

Resistor (R1) [kΩ]	12 V cut-out [V]	12 V cut-in [V]	12 V max. Voltage [V]
0	9.60	10.90	17.0
0.17	9.73	11.03	17.0
0.34	9.86	11.16	17.0
0.54	10.00	11.30	17.0
0.75	10.12	11.42	17.0
0.97	10.25	11.55	17.0
1.23	10.38	11.68	17.0
1.50	10.52	11.82	17.0
1.81	10.65	11.95	17.0
2.15	10.78	12.08	17.0
2.53	10.91	12.21	17.0
2.96	11.04	12.34	17.0
3.44	11.17	12.47	17.0
3.99	11.30	12.60	17.0



Wire Dimensions DC

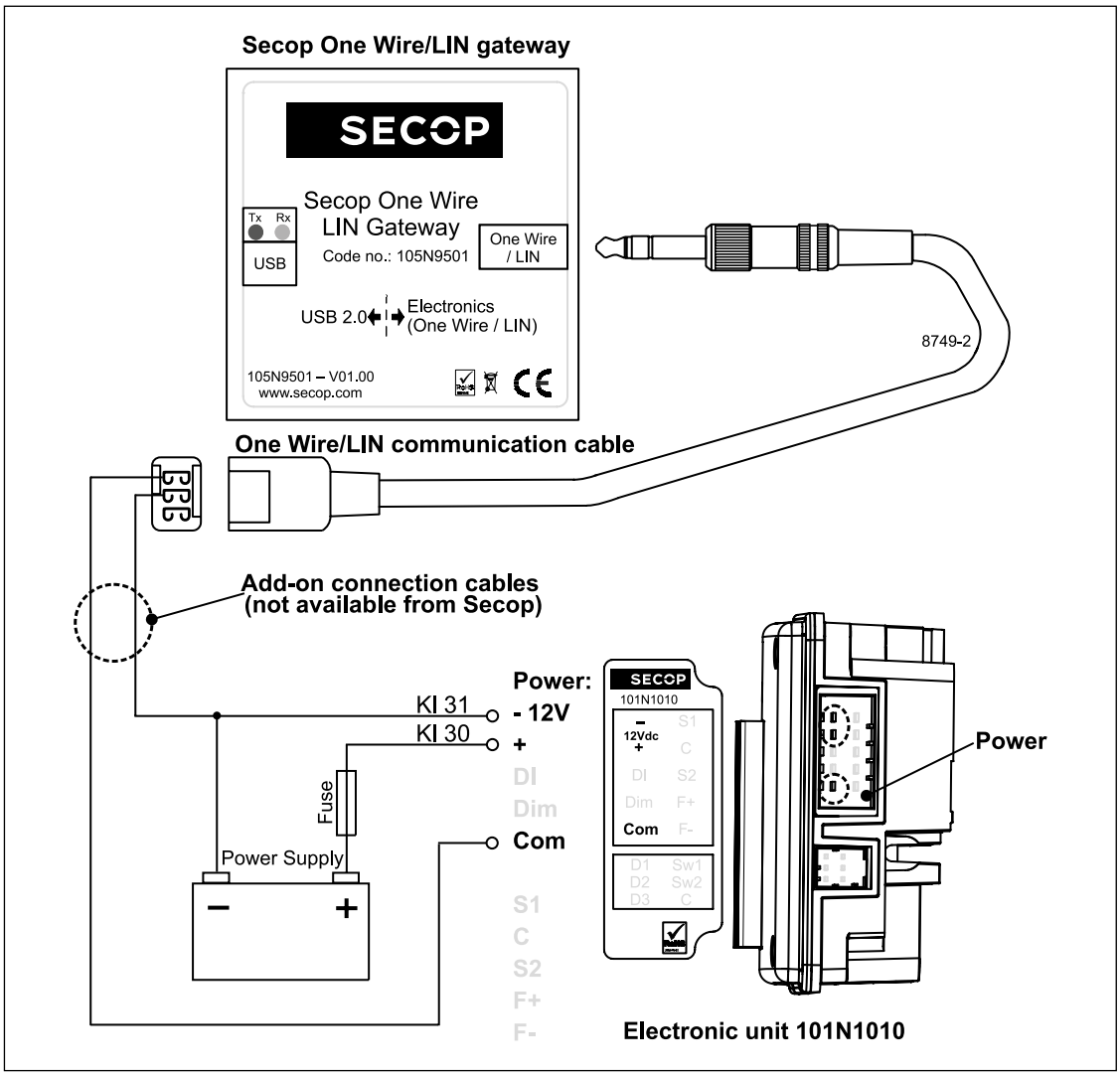
Size		Max. length* 12 V operation	
Cross section	AWG		
[mm²]	[Gauge]	[m]	[ft.]
2.5	12	2.5	8
4	12	4	13
6	10	6	20
10	8	10	33

*Length between battery an electronic unit

Operational errors

Error code	Error type Can be read out in the software TOOL4COOL®
7	**Communication failure**
6	**Thermostat failure** (If the NTC thermistor is short-circuit or has no connection, the electronic unit will enter manual mode).
5	**Thermal cut-out of electronic unit** (If the refrigeration system has been too heavily loaded, or if the ambient temperature is high, the electronic unit will run too hot).
4	**Minimum motor speed error** (If the refrigeration system is too heavily loaded, the motor cannot maintain minimum speed at approximately 1,850 rpm).
3	**Motor start error** (The rotor is blocked or the differential pressure in the refrigeration system is too high (→5 bar)).
2	**Fan over-current cut-out** (The fan loads the electronic unit with more than $0.65A_{peak}$).
1	**Battery protection cut-out** (The voltage is outside the cut-out setting).

Secop one wire/LIN gateway



BD1.4F-AUTO-AUTO – SMALL BUT POWERFUL

Lose excess weight and use the extra space for what really matters. The new **BD1.4F-AUTO** from Secop is 60% smaller than previous models and weighs in at only 2.3 kilos. Perfect for 10-15 litre in-car cabinets that need to fit into tight spaces without compromising storage space.

Specially designed for maximum efficiency and reliability this tiny powerhouse of a compressor makes it easier than ever to provide leading class mobile fridges to the discerning automobile manufacturers. The optimized, low-noise motor ensures outstanding performance when you want to provide that extra degree of luxury on the move.
Cool beverages on demand make driving so much more of an experience. Fridges using the BD Micro take up less space and allow small fridges to fit easily, with maximum storage space for snacks and beverages. Low energy consumption is good for car batteries – and the environment.




OUR JOURNEY SO FAR

1956
Production facility and headquarters in Flensburg, Germany founded

1958
Start up production of PW compressors.

1970
Introduction of SC compressors.
The birth of a standard setting platform in the light commercial market.

1972
Introduction FR compressors.

1977
Introduction TL and BD compressors.

1990
Introduction NL compressors.

1992
Introduction PL compressors.

1993
Start of production with natural refrigerant R600a (Isobutane)

Production facility in Crnomelj, Slovenia founded.

1999
Start of production with natural refrigerant R290 (Propane).

2002
Production facility in Zlate Moravce, Slovakia founded.

2005
Introduction GS compressors.

2008
Production facility in Wuqing, China founded.

2010
Introduction SLV-CNK.2 and SLV-CLK.2 variable speed compressors.
Introduction BD1.4F Micro DC compressor.
Introduction of DLX and NLU compressors.

2013
Introduction of the XV compressor. Opening a new chapter in refrigeration history.

Secop GmbH · Mads-Clausen-Str. 7 · 24939 Flensburg · Germany · Tel: +49 461 4941 0 · **www.secop.com**

Produced by Secop | June 2013

DES.S.100.A2.02