X700

in-vehicle telematics platform

hardware description

- ultra-robust integrated AVL solution
- designed for fleet management systems
- GPRS modem for TCP/IP connectivity
- universal 12/24V automotive power supply
- engine immobilizer on unauthorized access
- RoadAssistance & PanicButton inputs
- CAN V2.0B interface
- iButton interface for driver identification
- internal backup LiPo battery

Product summary

X700 is an embedded Java platform designed for fleet management systems, combining a state-of-art processing ARM9 core and GSM/GPRS modem with automotive power supply, interfaces to in-vehicle equipment and external GSM antenna. The core of the system is TC65i, a high-performance open-platform Java module from Cinterion. Standard CAN FMS interface is used to read speed, mileage, fuel and other useful information from vehicle's ECU. Three digital inputs are used to read status of ignition key, road assistance button or panic button and one digital output is used for engine cut-off on unauthorized access. A GPS receiver can be connected on the RS232 interface for precise location of vehicles. Other sensors like Temperature, iButton for driver identification or extra Analog/Digital inputs can be interfaced via the OneWire bus. The system has an external small GSM antenna. The device can be equipped with optional internal LiPo battery, as a backup power supply.

1. Dimensions

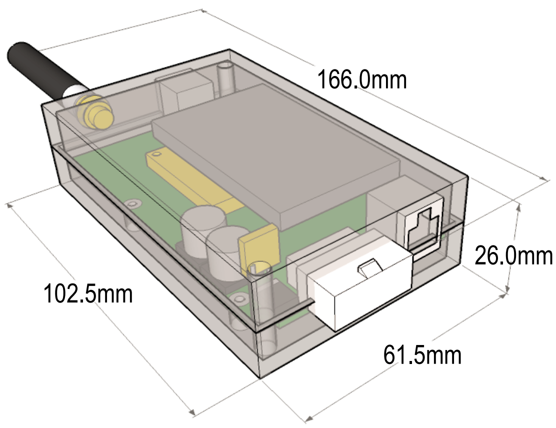
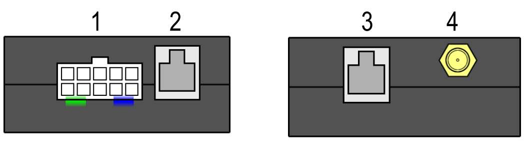


Fig. 1 - External dimensions

2. Interface specifications

Item	Name	Description
1	GPIO	10-pole Micro Mate-N-Lock plug for Power, GPIO, CAN and RS232
2	GPS	6-pole RJ11 plug for RS232 and Vcc
3	OW	4-pole RJ11 plug for OneWire and Vcc
4	ANT	SMA female connector for GSM antenna

Table 1 - Device connectors



front view   back view

3. Typical application block diagram

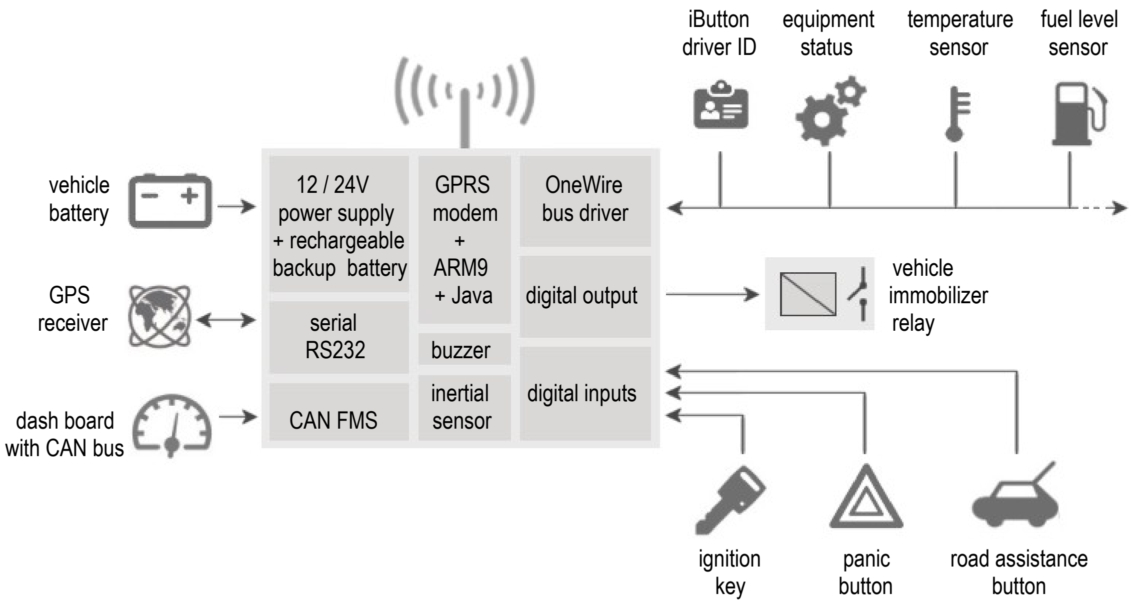


Fig. 2 - Typical application block diagram

4. In-vehicle connection with GPIO plug

The X700 device is designed to be installed inside the monitored vehicle and connected directly to the vehicle's electrical wiring. For this purpose, the automotive type 10-pin GPIO connector provides the following functions and interfaces:

- power supply
- programmable digital I/O
- CAN interface
- RS232 interface

Pin	Signal name	I/O	Function
1	RXD	I	Receive data from DTE
2	CANL	I/O	CAN dominant LOW
3	ASSIST	I	Road assistance button input
4	IGNITION	I	Ignition Key input
5	GND	-	Power and signal ground
6	POWER	+	Power supply
7	IMOB	OC	Output for engine cut-off relay
8	PANIC	I	Panic Button input
9	CANH	I/O	CAN dominant HIGH
10	TXD	O	Transmit data to DTE

Table 2 - GPIO connector pin assignment

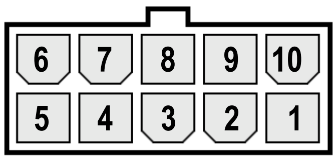


Fig. 3 - GPIO plug connector front view

5. Power supply

X700 integrates a universal power supply, able to work with any automotive voltage source, 12V or 24V. The power supply must comply with absolute maximum ratings from Electrical characteristics (see chapter 14). The device is equipped with protection circuits for over-voltage, over-current and over-temperature. The power supply must be compliant with the EN60950 guidelines.

6. LiPo battery for backup power supply

For applications requiring a backup power supply, X700 can be equipped with internal Lithium-Polymer rechargeable battery, for up to 5 hours of continuous GPRS data communication.

6.1. Battery only mode

When running only on internal LiPo battery, without the external power supply from the vehicle, external devices are not powered with 5V nominal voltage from X700. In this battery only mode, X700 can still read or write I/O pins and perform GSM/GPRS communication.

At software level, devices equipped with internal LiPo battery can detect external power loss and generate alarms and notifications.

7. Digital I/O

The device has 4 GPIO pins: 3 digital inputs and 1 digital output, with functionality defined by software.

As specified in Table 3, ASSIST and PANIC inputs are active low and may be configured to generate an alarm when connected to GND.

IGNITION signal is active high. This pin isn't used to start the device, as the device starts automatically after power up.

The IGNITION input refers to the vehicle's Ignition Key and is used only at software level to detect if the engine is running or not.

IMOB is an open collector output, capable of driving directly power relay. The output has protection circuits for over-current and coil reverse voltage.

The power supply and digital I/O circuit is detailed in fig. 4 and hardware-software interface in table 3.

Name	Active	HW Level	SW Level
IGNITION	high	0 / 1 / HiZ	1 / 0 / 0
ASSIST	low	0 / 1 / HiZ	0 / 1 / 1
PANIC	low	0 / 1 / HiZ	0 / 1 / 1
IMOB	low	0 / 1 / HiZ	0 / 1 / 1

Table 3 - Hardware-Software interface specifications

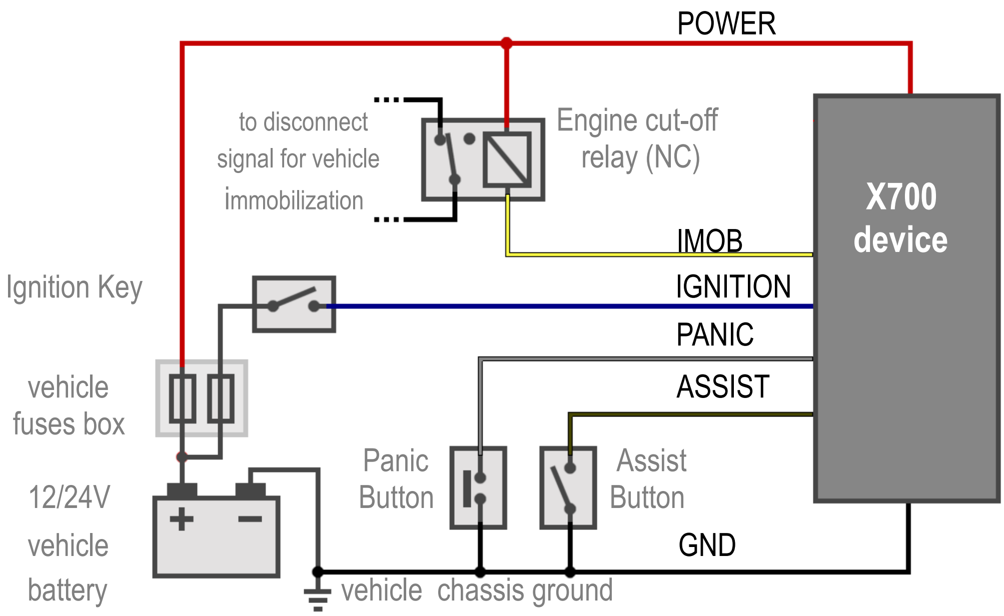


Fig. 4 - Power supply and digital I/O circuit

8. CANbus with FMS standard protocol

X700 has on-board CAN V2.0B interface for connection to vehicle's internal CANbus network.

The CAN transceiver is fault-tolerant, suitable for 12V and 24V systems and implements ISO-11898 standard physical layer requirements. Each device has on-board CAN network terminator.

The CAN controller communicates with the TC65i module via the high speed SPI bus.

At software level, the FMS standard protocol is used to collect data from vehicle's dashboard equipment.

The vehicle must have the FSM gateway activated.

9. OneWire bus

The OneWire interface extends the capabilities of X700 device. Multiple digital sensors, analog and digital inputs or LCDs can be connected on the same OneWire bus.

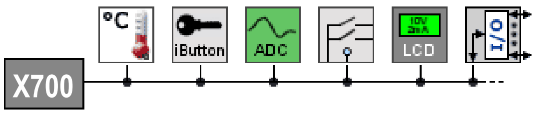


Fig. 5 - External devices attached to OneWire bus

Most of the OW devices require only one wire for bidirectional data transfer and a ground wire for reference. X700 provides also a 5V wire for external devices that require a power supply, such as LCDs.

The OW interface and power supply for external devices is not available in battery only mode.

Pin RJ11-4	Signal	I/O	Function
1	OWVDD	+	sensor power supply
2	OW	I/O	sensor data
3	OWGND	-	power and signal ground
4			not connected

Table 4 - OW connector pin assignment

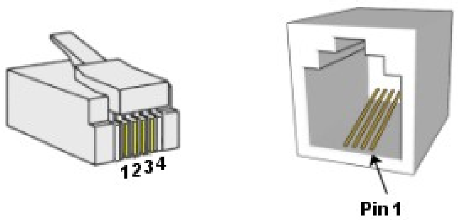


Fig. 6 - OW connector and plug front view

10. Serial RS232 interface

The RS232 serial interface of the X700 device is intended for the communication between the internal TC65i module and the external host application.

X700 acts as a DCE device for other DTE equipments connected to the serial interface.

In AVL applications, the serial interface is used for direct connection of a GPS receiver. The interface connector provides RS232 communication and handshaking signals, and also 5V supply for powering the external GPS receiver (see chapter 14.3.Characteristics of RS232 interface).

The RS232 serial interface has 2 connectors:

- **GPIO** with only RXD/TXD signals
- **GPS** with RXD/TXD, RTS/CTS signals and power supply output

Pin RJ11-6	Signal	I/O	Function
1	CTS	I	Clear To Send from DTE
2	GND	-	power and signal ground
3	TXD	O	Transmit data to DTE
4	RXD	I	Receive data from DTE
5	VDD	+	power supply output
6	RTS	O	Request To send to DTE

Table 5 - GPS connector pin assignment

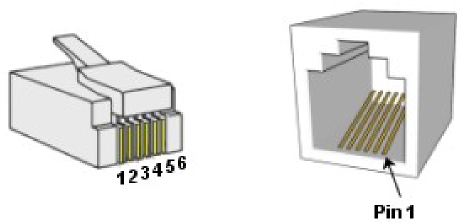


Fig. 7 - GPS connector and plug front view

RXD and TXD signals are common for both GPIO and GPS connectors, but only one connector must be used by the external application. Simultaneous connection on both connectors may damage the serial interface of connected devices.

11. Antenna interface

For GSM/GPRS communication, an external RF antenna with SMA type connector must be connected to the ANT connector of the device in order to achieve optimum RF performance.

12. SIM interface

The SIM interface is intended for 3V and 1.8V SIM cards. The card holder is a 5-wire interface according to GSM 11.11, assembled on the back of the electronic board, not accessible from outside the enclosure.

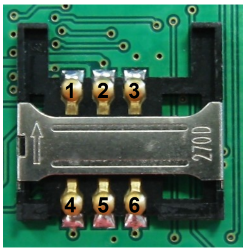


Fig. 8 - SIM holder pin assignment

Pin	Signal	I/O	Function
1	CCVCC	+	supply voltage for SIM card
2	CCRST	O	chip card reset
3	CCCLK	O	chip card clock
4	CCGND	-	ground
5	CCVPP		not connected
6	CCIO	I/O	serial data line, bi-directional

Table 6 - SIM card holder pin assignment

13. Status LEDs

Two status LEDs are used for quick debugging of X700 device: green PowerLED and blue SyncLED.

SyncLED behavior	Operating Status
Permanently OFF	POWER DOWN mode or CHARGE ONLY mode
600ms on 600ms off	Limited Network Service No SIM card or PIN inserted or network search in progress
75ms on 3s off	IDLE mode Is registered to GSM network, with not data transfer in progress
75ms on 75ms off 75ms on 3s off	GPRS context activated
500ms on 50ms off	GPRS data transfer in progress
Permanently ON	Malfunction (please contact service)

Table 7 - PowerLED display code

PowerLED behaviour		Operating Status
Permanently OFF		No external power
Permanently ON		External power connected

Table 8 - PowerLED display code

14. Electrical characteristics

14.1. Absolute maximum ratings

Parameter		Min	Max
Supply input voltage		7V	33V
Interface output supply voltage with external power	without backup battery	+4.6V	+4.8V
	with backup battery	+ 5.1	+ 5.4V
Internal backup battery		- 1.7V	+ 4.5V
RS-232 interface	receiver (RXD, CTS)	- 25V	+ 25V
	driver (TXD, RTS)	- 13.2V	+ 13,2V
DC voltage at CANH, CANL		- 42V	+ 42V
DC voltage at OW		- 0.5V	+ 14V
Digital inputs		- 6V	+ 33V
Digital output (open collector)		- 6V	+33V
ESD air discharge protection		- 8kV	+ 8kV
ESD contact discharge protection		- 4kV	+ 4kV

Table 9 - Absolute maximum ratings

14.2. Characteristics of power supply

Parameter	Description		Typ	Max
V_{POWER}	operating voltage		12V	30V
I_{POWER}	average supply current @ 25°C, worst case GSM900			
	Power Down	@ 12V	0.50mA	
		@ 30V	0.80mA	
	IDLE	@ 12V	36mA	
		@ 30V	21mA	
	Data GPRS 1TX / 4 Rx	@ 12V	173mA	
		@ 30V	77mA	
$I_{POWER\_P}^{2}$	Peak current during GPRS	@ 12V	910mA	
		@ 30V	340mA	
$t_{PLUS\text{-}Fail}$	Allowed power fail time without device reset or power down			1ms
	Allowed power fail time without RTC reset		6s	
V_{BATT}	internal battery operating voltage		3.7V	4.2V
I_{BATT_CHARGE}	internal battery charge current		500mA	

Table 10 - Characteristics of power supply

14.3. Characteristics of RS232 interface

Function	Signal	I/O	Specifications
RS232	RXD CTS	I I	RImin = 3kOhm $V_I$max = ±25V
	TXD RTS	O O	$V_O$min = ±5.4V at 3kOhm load
POWER	VDD	 O O	with 12/24V power supply input V_O = 4,65V without backup battery V_O = 5,2V with backup battery
		N/C	without 12/24V power supply input V_O = 0V backup battery only

Table 11 - Characteristics of RS232 interface

14.4. Characteristics of CAN interface

Function	Parameter	Specifications
CAN	Dominant output voltage range	V_O(CANH) = 2.75V...4.75V V_O(CANL) = 0.50V...2.25V
	Differential output voltage range	V_{DIFF}(r)(o) = - 0.50V...+ 0.05V V_{DIFF}(d)(o) = + 1.5V... + 3.0V
	Differential input voltage range	V_{DIFF}(r)(i) = - 1.0V...+ 0.5V V_{DIFF}(d)(i) = - 0.9V...+ 5.0V conditions: -2V < V(CANL, CANH) < +7V

Table 12 - Characteristics of CAN interface

14.5. Characteristics of OW interface

Function	Parameter	Specifications
OneWire	OW data line	V_{iH}min = 3.4V V_{iL}max = 1.8V
	Weak Pull-up Current	I_{WEAKPU} = 3mA (typical)
	Active Pull-up Current	$I_{ACTIVEPU}$ = 15mA (typical)

Table 13 - Characteristics of OW interface

14.6. Characteristics of GPIO interface

Function	Signal	I/O	Specifications
Digital Inputs	IGNITION	I	$V_I$max = 33V V_{iH}min = 1V
	ASSIST PANIC	I I	$V_I$max = 33V V_{iL}max = 1.5V
Digital Output for direct relay drive	IMOB	OC	V_{OL}max = 1V I_{OL}fuse = 140mA (resettable PTC) I_{OL}max/peack = 500mA / 800mA $V_I$max = 33V

Table 14 - Characteristics of GPIO interface

15. Cable specifications

The X700 device is delivered with a matching plug for the 10-pole GPIO connector. The plug is already crimped with 50cm long wires. Wires have distinct colors for quick and easy installation.

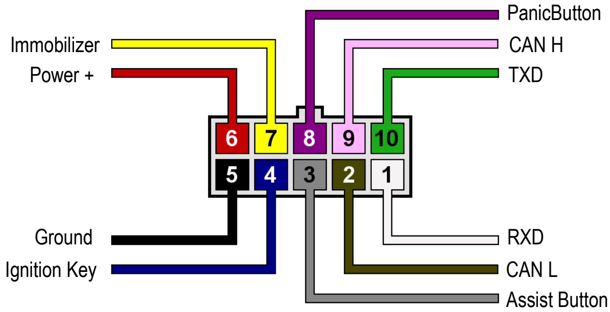


Fig. 9 - GPIO plug color code

16. Mechanical characteristics

Parameter		Value
Dimensions	enclosure extents	102.5 x 61.5 x 26mm
	with antenna & connector	166.0 x 61.5 x 26mm
Weight	without backup battery	180g
	with backup battery	90g
Protection class		IP42
Operating temperature		-30°C...+65°C
Air humidity		5...80%
Mechanical pulse acceleration		30g @18ms duration

Table 15 - Absolute maximum ratings

ETA AI S.R.L.
Via I° Maggio 142/B
60131, Ancona, Italia
sales@safefleet.eu
www.safefleet.eu

document number/date: X700.2.9 / 2010-01-07