CR-400™
Product Overview

Proprietary and Confidential

Version 1.1

Revised and Updated: July 2022

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1 Introduction

The purpose of this document is to describe the features and capabilities of this new platform of CR400 LTE product, and is intended for product, marketing, support and sales teams of Cellocator partners, integrators and service provider customers.

1.1 Document Scope

The document describes the high-level system features and capabilities of the CR400 New Platform. This document does not deal with the protocols and interfaces between the CR400 device and the SW backend, nor with the low-level algorithms, state machines and logic engine implemented to deliver a complete remote diagnostics and enhanced driver behavior system. These protocols, APIs, algorithms, and state machines are described in separate documentation, as listed in the following sections.

1.2 Definitions, Acronyms and Abbreviations

Name	Description
CR400	Cellocator's LTE based fleet management solution

Table 1 – Definitions, Acronyms and Abbreviations

1.3 References and Bibliography

No.	Document Name
1	Cellocator CR400 Programming Manual
2	Cellocator Wireless CR400 Communication Protocol
3	Cellocator Serial Communication Protocol
5	Cellocator Programmer Manual

Table 2 – References

1.4 List of Changes

Version	Change	Remarks	Date Approved
1.0	First Draft		27.2.2020
1.1	2nd draft		July 10, 2022

Table 3 – List of Changes

2 System Overview

2.1 General

The Cellocator CR-400™ is Cellocator's unit for the CR platform supports LTE cellular communication. The intended market for the CR400 is Track&Trace and security applications.

The CR-400 is currently available in two modems variants:

1. LTE CAT M1 network with 2G fallback modem
2. LTE CAT 1 network with 2G fallback modem.

The CR-400 is based on the CR300B. Several features and improvements have been added to the product, as detailed in this document. The CR400 supports all available maintenance and debugging (excluding external debug line) features as at CR300.

The CR-400 is equipped with a built-in BLE 5 (in one of its variants) and Cellular and GNSS LEDs indications.

In addition, the CR-400 now includes driver behavior logic.

2.2 Hardware

The CR400 includes the following:

- **Two Modems variants**:
  - LTE CAT M1 with 2G fallback (Worldwide)
  - LTE CAT-1 with 2G fallback (EMEA, APAC, LATAM)
- **SIM Holders**:
  - Nano SIM or eSIM
- **GNSS**: GPS+GLONASS
- **Backup battery**: 1000mAh
- **1-wire** port (Dallas) for Driver-ID
- temperature sensor
- **Memory** supporting 5000 logged events
- **Accelerometer** for Motion sensor, driver behavior and crash detection
- **Ignition** input
- Two multipurpose **GPIOs** supporting digital input or output
- Two multipurpose Inputs, that can be configured as digital /analog/frequency
- **Gradual immobilizing** as one of the outputs (LEDs or Lights output)
- **RS232** Serial port for maintenance
- **2 LEDs** indication (Cellular, GNSS)
- **10-pin** main Molex connector

2.3 System Narrative

The CR400 fulfills the following objectives:

- It addresses the evolving fleet management market, which is trending towards Track & Trace (AVL), Stolen Vehicle Recovery (SVR) and Anti-theft.

- ◆ It keeps pace with industry standards of communication technologies, location finding sensitivity and accuracy, and jamming immunity via advanced Cellular and GPS/GNSS engines.

3 Feature Improvements

3.1 Two Multipurpose GPIOs

The CR400 supports two multipurpose GPIOs that support digital/discrete analog.

NOTE: When connecting 12V to a GPIO programmed as output, the port is likely to be damaged. Therefore, when programming the port as output, first validate that no voltage is connected.

In addition, there is no ability to test the output capabilities on the programmable GPIO.

| CR-400 – Plug Pinout Functionality						
Plug Pins	Pin Name	Pins Configurable Functionality. "*" Defines: Applicable by HW for selection by PL.				
		Analog Input	Digital Dry Contact Input	Digital "Wet" Input	Frequency Input	Output (Sink)
2	LED/ Lock		*			*
3	Lights/ Unlock		*			*
4	Ignition	*				
5	Doors	*	*	*	*	
9	Shock	*	*	*	*	
1	Main Power	POWER				
6	Main GND	GND				
7	RS-232 Tx	RS-232 Port				
8	RS-232 Rx					
10	1-Wire	1-Wire Interface				

Table 4 – Pinout Scheme
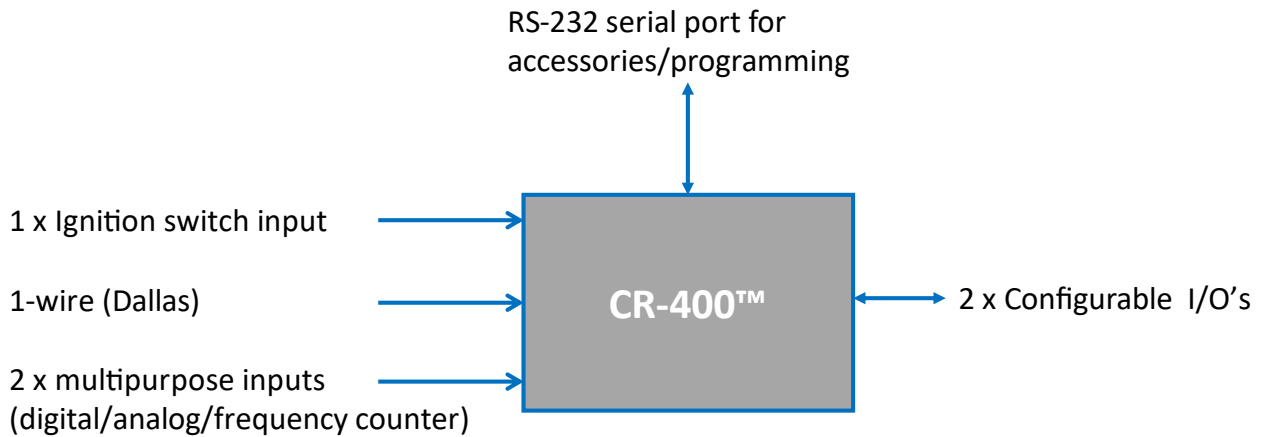
Figure 1 – CR-400 IOs

3.2 Modem FOTA

Addition to Cellocator's FW OTA, also the Modem FOTA (FW over the air) process is available. The modem downloads a new FW file and upgrades its own FW.

This feature is important in cases where a new modem FW is released or in cases when malfunctions are discovered in the modem (caused by the modem FW).

Upgrading the modem FW can only be managed by Cellocator CS.

3.3 Feature Authentication Codes

For dedicated customer projects, the "Feature Authentication Codes" option in the Programmer enables you to activate those special development projects into one source code with a "clean" PL that doesn't include non-relevant parameters.

In the Programmer, the code activation is entered in a dialog box (accessed via a toolbar button, as indicated below).
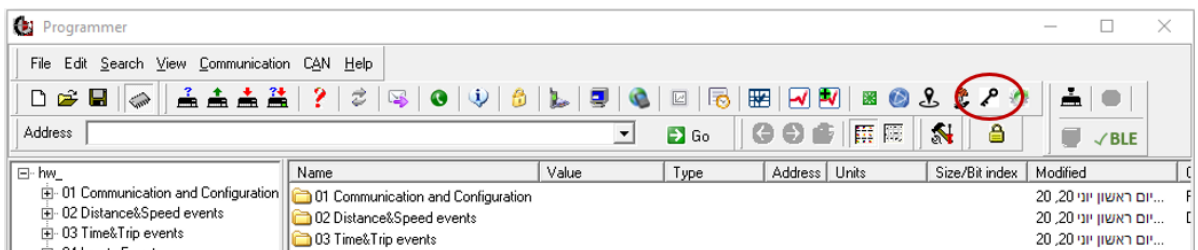
When connecting the Cello unit to the Programmer serial port for the first activation, you should click on the "Feature Authentication codes" toolbar icon and enter the code that was sent from Cellocator CS. By entering this code, the automatic relevant feature will be activated, and the relevant PL folders are displayed, which will be activated for any connected device.

This feature is also supported OTA, so devices already in the field which are upgraded to a new version will also get this activation feature. For this purpose, a secured API/protocol to send the activation code to the device via the customer's backend was developed.

3.4 Jamming Detection while Ignition is ON/OFF

Advanced jamming detection (configurable). This feature builds a logic relationship between jamming detection and ignition reaction.

Case	Jamming	Ignition	Action
1	Yes	Off	Activate the immobilizer output (i.e. Immediate, Nested, Gradual) while monitoring jamming for a predefined duration (default: 10 seconds).
2	Yes	On	Activate the immobilizer output (i.e. Immediate, Nested, Gradual) while monitoring jamming for a predefined duration (default: 15 minutes).
3	No	On/Off	Deactivate the immobilizer output after no jamming detection for a predefined period of duration (i.e. 10 minutes). The unit notifies in the first communication that jamming was detected.

Table 5 – Jamming Detection Logic

3.5 Basic Satellite Activation

Basic Satellite Activation enables the use of an alternative satellite communication channel when the GPRS network is unavailable.

The functionality enables the turning on of the satellite modem power when the CR400 unit is out of GPRS coverage, and to switch back to GPRS when GPRS communication is once again available.

3.6 Crash Detection Feature

The unit's accelerometer is used as a source for crash detection and reporting.

The feature includes two separate RMS-based thresholds, one for a light crash and one for a heavy crash.

The detection will not be possible when in full-hibernation mode (ignition is OFF).

Note that the light crash detection requires the unit to be installed horizontally for gravity to be eliminated.

3.7 Driver behaver

The following driver maneuvers will be monitored:

- Harsh acceleration
- Harsh braking
- Harsh turn
- Over speeding
- Accident detection

For each of the above-mentioned harsh maneuvers, the system shall provide two configuration parameters:

- Threshold in G for maneuver detection
- Threshold in Seconds for Minimum length of maneuver to be considered valid

3.8 Enable/Disable IP Up

The 'IP up' alert is generated with every dial-up to GPRS to update the Central Control with the resent IP address of the unit. In cases where the SIM card is associated with a static IP, it is possible to cancel IP up events.

3.9 RTC from the Network

This feature enables you to get RTC from the network for devices that are fixed and located underground.

3.10 Dallas Identifier in Ignition Off

This feature enables you to also get driver identification from the Dallas in Ignition Off mode.

3.11 Tilt Tamper

Tilt Tamper logic measures the orientation (by earth gravity) on each axis and changes that breach the configured angle threshold. When compared to the steady state for a longer time than the configured time threshold, the unit will report it.

4 Release Package Content

4.1 Evaluation Suite

The Cellocator Evaluation Suite Manual is a comprehensive guide that provides information required to run an initial appraisal and testing process of Cellocator units, without requiring connection to an actual vehicle during testing.

The Cellocator Evaluation Suite contains a complete set of components that simplifies bench testing of the system and serves as a demonstration platform for people wishing to understand the operational aspects of the system. The Suite is also intended to facilitate the development of interfaces to the Cellocator system by integrators or service providers.

4.1.1 *Cellocator Programmer*

The Cellocator Programmer enables you to perform the following:

♦ Modify a PL file to suit your communication needs.

♦ Upload and download PL files to Cellocator units via its serial interface.

♦ Test and debug units using a variety of features, including a platform manifest, the ability to test a unit's inputs and outputs, and the ability to forward data to a wireless channel.

The Cellocator Programmer is mainly used for the initial configuration of a unit, and typically communication settings such as the destination IP address, target port phone, and SMS numbers.
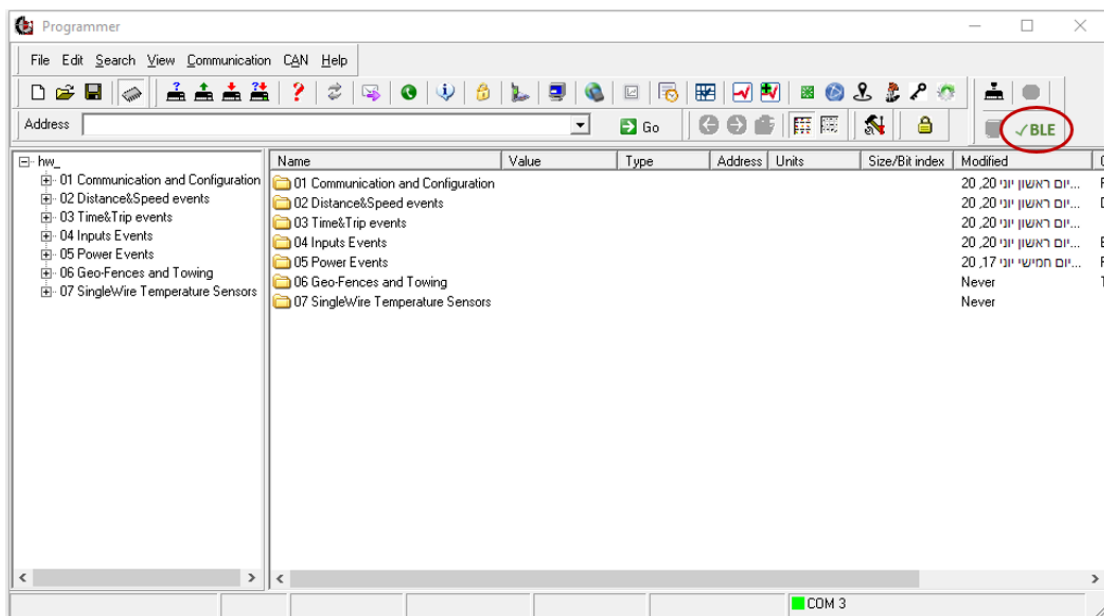
For more information, refer to the *Cellocator Programmer Manual*.

4.1.2 *Communication Center*

The CR-400 supports the use of the Communication Center tool. The Communication Center performs the following:

♦ Receives, parses and monitors GPRS and SMS messages.

♦ Sends commands through GPRS or SMS communications.

- Interrogates the unit to get the current location (in text format) and the unit status (inputs, outputs, GPS data, etc.).

- Receives and monitors emergency transmissions from the unit (input triggering).

- Controls the unit's outputs. Programs the unit's behavior OTA (by changing the unit's EEPROM content).

- Upgrades the unit firmware.

For more information, please refer to the *Cellocator Evaluation Suite Manual*.

4.2   Cellocator+

The Cellocator+ System is a web-based application that enables Cellocator customers to perform configuration and firmware updates to Cellocator devices and view the status of these updates in real time and through reports via an intuitive interface.

The Cellocator+ System supports customers wishing to directly view and modify their device information. The user can request displays of device data and status and configuration management, and can perform configuration updates by attaching PL (Programming Library) files or firmware versions to a device or set of devices while the system manages the programming session.

The Cellocator+ System has several important features and benefits, including:

- Provides Cellocator customers with all major provisioning tools at the click of a mouse.

- Eliminates the need for all customers to maintain provisioning tools in their systems.

- Reduces time to market for new customers.

- Provides reports on update history (to be implemented in future versions).

- Cellocator+ manages the whole device management process.

- Customers can view update statuses in real-time through the Web.

4.3   Integration Package

The Cellocator Gateway is a set of SW components offered to Cellocator customers wishing to integrate the Cellocator OTA protocol into their production environment.

Customers using Cellocator Gateway benefit from a quicker and easier integration process and are also entitled to software upgrades, technical support and more. Cellocator Gateway is a multi-platform solution and can run on Windows or selected Linux OS. The integration package provides high availability and load balancing options, as well as enabling clients the opportunity to integrate and start working with Cellocator units without investing a large amount of time and resources.

5   Optional Equipment

The CR400 optional equipment's are listed in the table below.

Name/Part Number	Description	Picture
PN: CT7801217-xxx	**CR400** Mid-level fleet device (CAT M1 and CAT-1 modems)	
Ten wire mold main Harness **PN**: 711-00412	10 wire harness, which supports all CR400 interfaces (inc. serial port)	
Simulation harness **PN:** 711-00413	CR400 Vehicle Simulator Harness	

Table 6 – CR400 Components

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6 Documentation

The product is supported by set of documents including Evaluation, Integration and Installation manuals, Protocols description, programming reference etc. For more information, refer to the documents listed in section 1.3.

7 Technical Specifications

Cellular Communication		
	LTE CAT M1 with 2G fallback, worldwide	LTE CAT-1 with 2G fallback (EMEA, APAC, LATAM)
Supported Technologies & Bands	• CAT M1: B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B26, B28. • 2G: B2(1900), B3(1800), B5(850), B8(900)	• CAT-1: B1, B2, B3, B4, B5, B7, B8, B20, B28, B38, B40, B41 • 2G: B2, B3, B4, B8
Data rates	• LTE CAT M1: Uplink - up to 375 kbps, Downlink - up to 300 kbps • EGPRS (2G Fallback): Uplink, up to 236 kbps, Downlink - up to 296 kbps	• LTE CAT-1: Uplink - up to 5Mbps, Downlink - up to 10Mbps • EGPRS (2G Fallback): Uplink - up to 210 kbps, Downlink - up to 264 kbps
SIM Card Compatibility	Nano SIM.	
Antenna	Internal	
Packet Data	TCP/IP, UDP/IP	
SMS	PDU	
Local Communication Interfaces		
BLE	BLE 5, Wireless Connectivity, with PC & Smartphones.	
RS-232 Port	Wired Serial Communication. 9600 bps or 115000 bps, 8 bits; 1 Stop Bit; No Parity. May be used for Configuration Update / Firmware Upgrade.	
1-Wire™ (Dallas port)	DS1990A, DS1971 compliant for driver management. Extended bus current source with 7mA driving capability. DS18B20 compliant for temperature sensors.	
GNSS		
Sensitivity (Tracking)	-161 dBm	-160 dBm
Acquisition Average TTFF	Cold 32 s; Warm 21 s; Hot <1 s	Cold Start: < 28 s, Hot Start: < 1 s
Antenna	Internal	Internal
Configurable Discrete Inputs / Outputs		
Connector Pin 2	• When configured as Dry Contact Input: Contact Sink to GND.	

(LED/Lock)	• When Configured as Output: Open Drain Sink Output. o ON & Loaded: 250 mA max (Assignable functionality by configuration)
Connector Pin 3 (Lights/Unlock)	• When configured as Dry Contact Input: Contact Sink to GND. • When Configured as Output: Open Drain Sink Output. o ON & Loaded: 250 mA max (Assignable functionality by configuration)
Connector Pin 4 (Ignition)	Ignition Switch signal Analog Input: *0V–32V range. (Assignable functionality by configuration)
Connector Pin 5 (Doors) Connector Pin 9 (Shock)	• When configured as Analog Input: 0V-30V DC range. • When configured as Dry Contact Input: Sink to GND. • When configured as Digital "Wet" Input: 0V-30V VDC range, Configurable Threshold. • When configured as Frequency Counter: 0Hz-5kHz range@ configurable Amplitude. (Assignable functionality by configuration)
Internal Analog Input	Vehicle Power Voltage monitoring (Assignable functionality by configuration)
Internal Analog Input	Internal Regulated, System Power Voltage monitoring. (Assignable functionality by configuration)

Accelerometer	
Internal	3D, 16g range, 12-bit representation, 1mg resolution

Display	
LED Indicators	GNSS Status LED & Cellular Connectivity Status LED. Operates only during installation and shuts off after installation completion.

Connector	
1	10 pin connector.

Power	
Input Voltage (Vehicle Power)	9-32 VDC
average Current Consumption, 12V Power Installation	Normal (during idle with BLE on): 19mA Hibernation with BLE ON: 3.3mA Hibernation with BLE OFF: 2.1mA Shipment (Off): <20uA (Internal Battery)
Internal Backup Battery	Li-Ion Polymer, 3.7V, 1000mAh, rechargeable Embedded NTC for temperature-controlled charging Operating Temperature: -20°C (65% charge) to +60°C Charging Temperature: 0°C to +45°C Battery Monitoring: Temperature (NTC) & Voltage Autonomy: 140 messages from a fully charged battery in a TX Rate of once per 5 Minutes @ room temperature

	Protections: over current, overcharge and over discharge
Vehicle Environment Immunity	
Immunity	Compliant with ISO 7637 till test level #4 (In accordance with E-mark directive)
Applicable Environmental Conditions	
Operating Temperature	-30°C to +70°C full performance (External Power)
Storage Temperature	-20°C to +45°C
Humidity	95% non-condensing
Protection	IP40 (Upgradable to IP 66 with added protector accessory)
Climatic, Vibration, Impact	ISO 16750
Vehicle Installation Methods	
Mounting	Tie-Wraps and/or Double-Sided Adhesive Tape
Certifications	
FCC	Part 15 Subpart B, part 22/24 compliant
PTCRB	All Applicable Bands
CE	Radio Equipment directive (RED) 2014/53/EU CE EMC Article 3.1(b) Electromagnetic Compatibility CE Radio Article 3.2 Effective Use of Spectrum CE Safety Article 3.1(a) Health & Safety Automotive Directive 2004/104/EC (E-Mark)
IC	Industrial Canada
1-wire temperature sensor ratings EN12830	Suitability: T Climatic environment: • w/o CR Protector – B • with CR Protector – D Accuracy class: • (-10)°C to (+85)°C - 1 • <(-10)°C, > (+85)°C - 2 Range: -55°C to +125°C
Environmental Protection	
RoHS	Directive 2011/65/EU, including Directive (EU) 2015/863 amendment.
Conflict Minerals Law	Production Conformity with U.S. Conflict Materials provisions of the Dodd-Frank Wall Street Reform and Consumer Protection Act, HR 4173, Section 1502 (Conflict Minerals Act).

Dimensions and Weight	
Dimensions	90.8 x 70.5 x 22.9 mm
Weight	130gr (unpacked, without harness, battery included)
Harness	
P/N: 711- 00412	Full harness, including RS-232 serial communication plug.

Table 7 - Technical Specifications

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