USER MANUAL TRUGRD LR

PROJECT TITLE:
TRUGRD LR USER MANUAL

PROJECT NO.:

KEYWORD(S):
TRUGRD LR RADAR SENSOR

DATE:
28 NOVEMBER, 2022

STATUS:
IN PROGRESS

1   CONTENTS

2 ABBREVIATIONS

CAN   Controller Area Network
DSP   Digital Signal Processing; Digital Signal Processor
FMCW   Frequency Modulated Continuous Wave
RS485   Physical communication layer standard EIA RS-485
SOC   System on Chip
UMRR   Universal Medium-Range Radar

3   INTRODUCTION

This document is a short documentation of the general purpose <u>u</u>niversal <u>m</u>edium <u>r</u>ange <u>r</u>adar TRUGRD LR radar sensor with type 49 antenna.

4 GENERAL DESCRIPTION

4.1 SENSOR DESCRIPTION

The main task of the UMRR is the detection of any reflectors in the field of view, to measure the distance, the relative speed and the angle to the shortest reflector (and to other reflectors), to detect motion and to track (filter) the results over time.

For this general purpose measurement application, range and relative radial speed and the angle value of each reflector inside the antenna beam are measured and the results are reported via the communication links cycle by cycle.

4.2 TRANSMIT SIGNAL

The UMRR transmit frequency is in the 24 GHz ISM band (24000 MHz to 24250 MHz).

Antenna type 49 consists of one TX antenna with 8 uniform RX antennas. The TX antenna have a 3dB antenna beam width of +-9° in azimuth and +-5,5° in elevation. The 8 RX antennas have a 3dB antenna beam width of +-12° in azimuth and +-4.3° in elevation. Highest TX antenna sidelobe: +-32°, highest RX sidelobe at +-43° in azimuth.

Note: max. Gain for TX antenna have max. gain of 19.4 dBi at boresight. The RX Antenna has a maximum gain at boresight of 15.3 dBi.

4.3 GENERAL PERFORMANCE DATA

After power up or reset, the sensor readings are within specified performance within <10 seconds. In Table 4-1 the general performance data of TRUGRD LR are given.

Table 4-1: General performance data

Environmental		
Ambient Temperature	-40 … +80	degree C
Shock	100	g_rms
Vibration	14	g_rms
IP	67	
Pressure / Transport altitude	0…10.000	m
Mechanical		
Weight	≤ 200	g
Dimensions	Figure 5	
Housing Identification	07	
Antenna Identification	49	
DSP Board Identification	12	
General		
Power Supply	7 … 32 [I]	V DC
	5	W
Frequency Band	24.0…24.25	GHz
Bandwidth	< 250	MHz
Interfaces	CAN V2.0b (passive) RS-485 Ethernet 100Mbit	
Connector	Hirose LF10 series	CAN, Power, RS485, Eth.

[I] measured at connector

[II] measured at connector, min. voltage slew rate 500V/s or max. voltage rise time 15ms; supply source impedance 0.5Ohms.

[III] Typical value 9W @20°C, may slightly increase over temperature.

4.4 SOFTWARE AND FIRMWARE VERSION

The software in the TRUGRD LR radar processor has Version 6.

5   HARDWARE

5.1   UMRR SENSOR

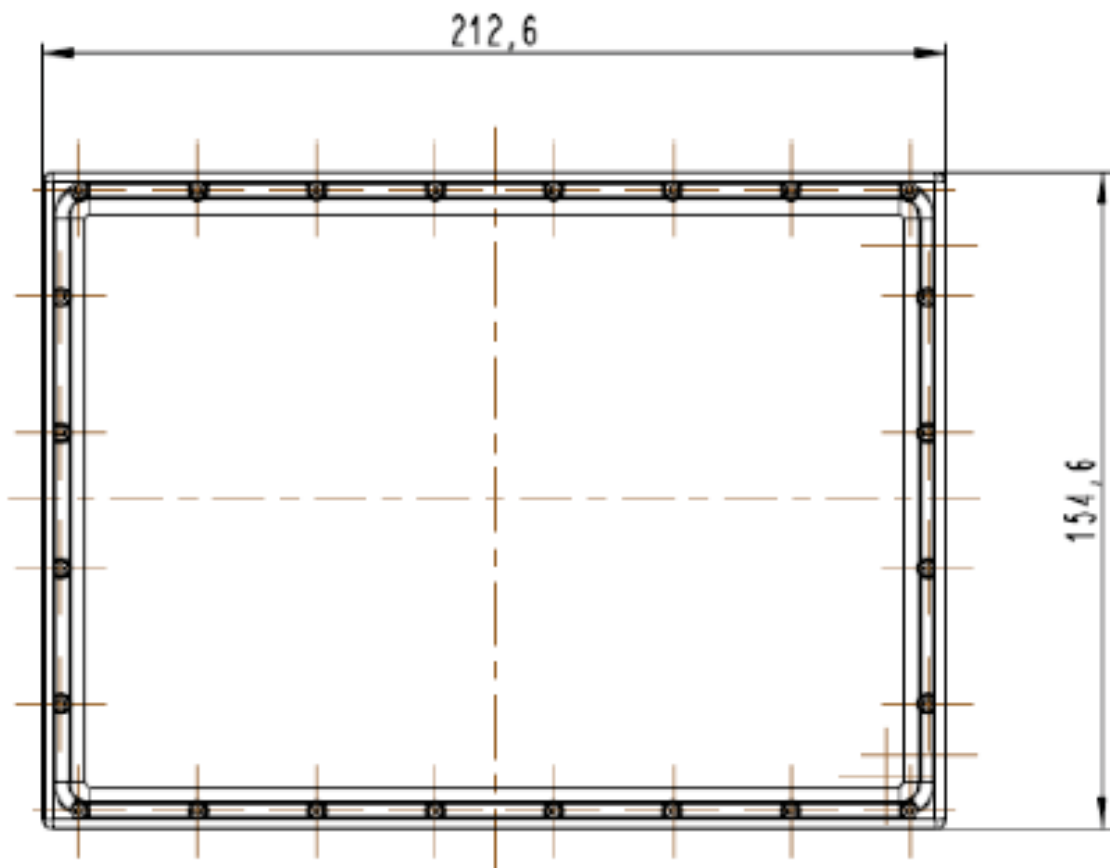An example picture of a UMRR (universal medium-range radar) sensor (housing type 070E01) is shown in the figures below.

Figure 1: Housing Type070E01 TRUGRD LR FRONT

Figure 2: Housing Type 070E01 TRUGRD LR BACK

5.2   SENSOR DIMENSION

Sensor Front Side

Figure 3: Sensor Dimension FRONT

Figure 4: Sensor from LEFT, TOP, RIGHT SIDE
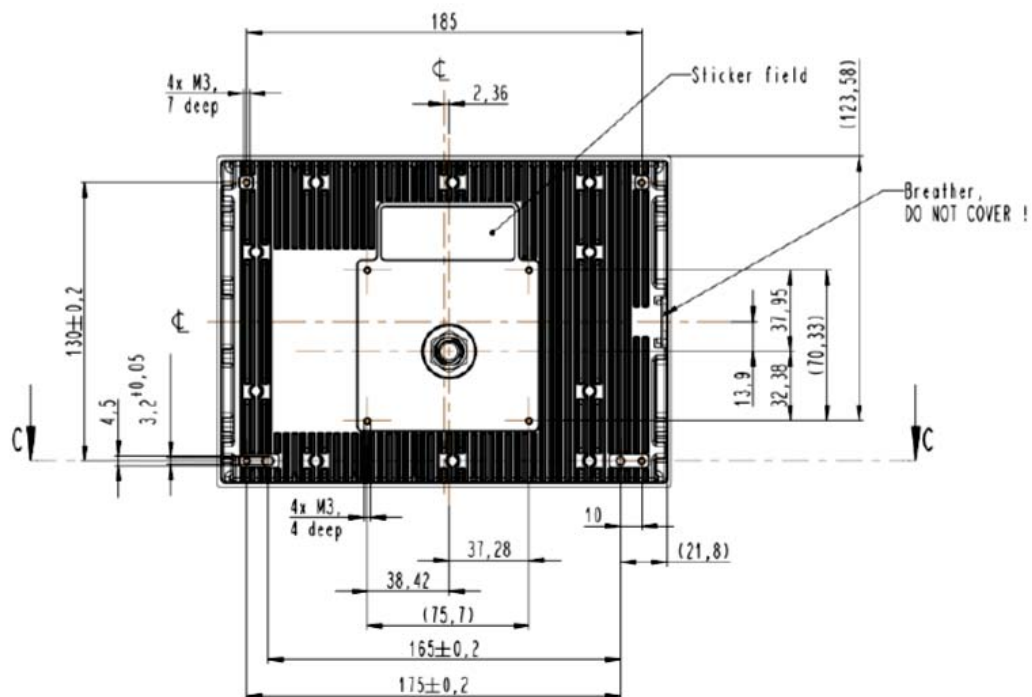

Figure 5: Sensor Dimension TOP VIEW BACK

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6 CABLES AND CONNECTORS

6.1 SENSOR CONNECTOR

The sensor connector is a 12-pin male (plug) circular bayonet type connector (water proof IP67, series LF10WBRB-12PD, manufacturer Hirose, Japan). A female counterpart (socket), e.g. LF10WBP-12S, is used to connect to the sensor. The pin numbering of the socket is shown in Figure 6 the pin description is given in Table 6-1.
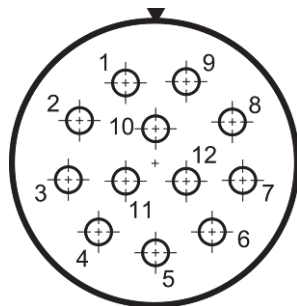

Figure 6: View on solder cup side of socket (rear view of female counterpart to be connected to sensor)

Table 6-1: Sensor connector pin out model TRUGRD LR

Pin No.	Function	Wire Color (MEDI type #KU110C12J002)
1	SENSOR_ETH_TX1_P	gray / red
2	SENSOR_ETH_TX1_N	red / blue
3	SENSOR_RS485_RX_N	pink
4	SENSOR_RS485_RX_P	gray
5	SENSOR_RS485_TX_N	brown
6	SENSOR_RS485_TX_P	white
7	External GND	blue
8	V_SUPPLY	red
9	SENSOR_ETH_TX2_N	black
10	SENSOR_ETH_TX2_P	purple
11	CAN_H	green
12	CAN_L	yellow

Please note that in the standard configuration the sensor has 120 Ohms resistor on board (CAN bus termination between CAN_L and CAN_H).

For the RS485 data interface there is a 120 Ohms resistor on board of the sensor.

A number of cable sets for initial operation and test purposes are offered by Smartmicro, to deliver a fast set-up of a sensor system. Among those preconfigured ready-to-run cables as well as cable stumps (pig tail cables or various lengths) which carry the connector on one side and open wires on the other.

6.2 CAN DATA INTERFACE

This specification gives a detailed description of the CAN data communication used in the UMRR based systems on the sensor CAN. The UMRR is compliant with CAN 2.0B standard.

CAN is a very robust full duplex bidirectional interface.

6.3 CAN-SETTINGS

Baud Rate:	500 kBit/s or lower
T_{seg1}:	8
T_{seg2}:	7
T_{sjw}:	2 (SJW: synchronization jump width)

Above values for CAN bit timing are illustrated in Figure 7 used in the UMRR radar sensor (note: the CAN module is integrated in the DSP). For comparison purposes, Figure 8 the CAN bit timing as defined by the CAN protocol is shown.

The CAN bit timing parts as defined by the CAN protocol Figure 8 can be described as follows:

- **Sync**: This part of bit time is used to synchronize the various nodes on the bus. An edge is expected to lie within this segment. For the UMRR sensor, this segment is always 1 TIME QUANTUM (TQ).
- **Prop**: This part of the bit time is used to compensate for the physical delay times within the network. It is twice the sum of the signal's propagation time on the bus line, the input comparator delay, and the output driver delay. For the UMRR sensor, this segment is programmable from 1 to 8 TIME QUANTA (TQ).
- **Phase 1**: This phase is used to compensate for positive edge phase error. For the UMRR sensor, this segment is programmable from 1 to 8 TIME QUANTA (TQ) and can be lengthened by resynchronization.
- **Phase 2**: This phase is used to compensate for negative edge phase error. For the UMRR sensor, this segment is programmable from 2 to 8 TIME QUANTA (TQ) and can be shortened by resynchronization.
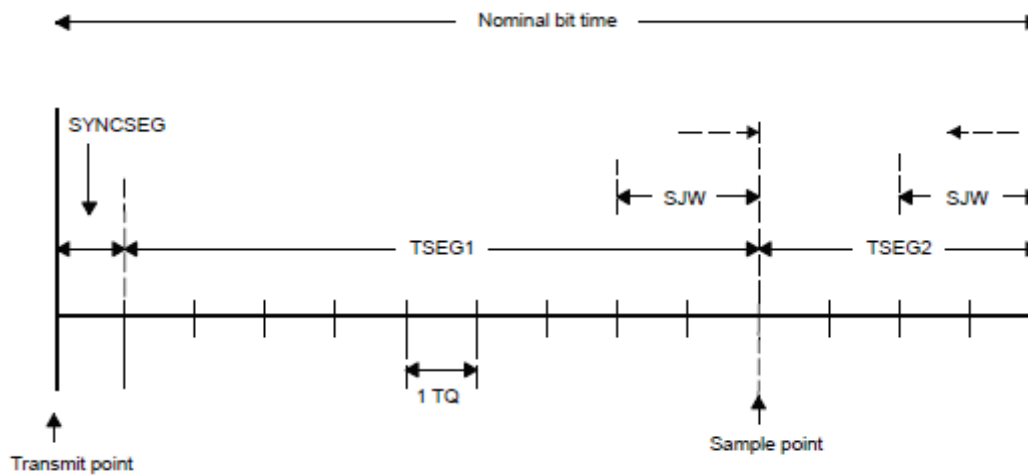
Figure 7: CAN bit timing for UMRR sensor
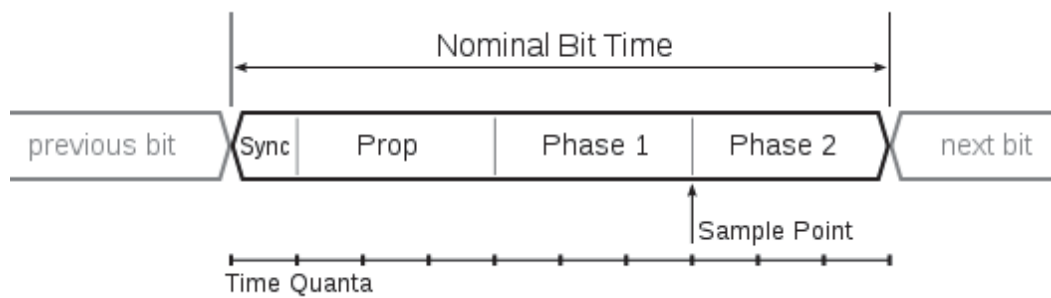

Figure 8: CAN bit timing as defined by the CAN protocol
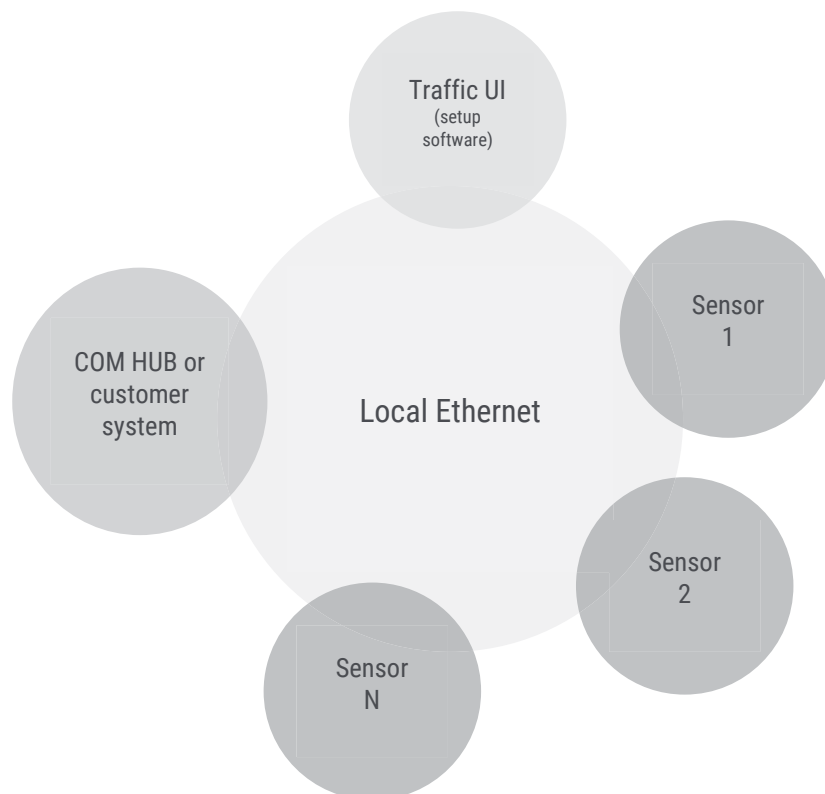
6.4   RS485 DATA INTERFACE

The RS485 interface from the UMRR sensor has a predefined speed of 115200 baud/s. Typical other data rates are between 921.6kBit/s and 56.7kBit/s.

6.5 ETHERNET CONNECTION

The sensor supports UDP via Ethernet in a Local Area Network (LAN). Communication over low bandwidth environments or routed networks such as the world wide web are not supported.

Features:

- Ethernet standards IPv4, ARP, IGMP, IP multicast and UDP
- smartmicro's proprietary communication protocol "smartmicro transport protocol" with:
  - o IP/UDP Multicast based discovery protocol
  - o Client ID based setup
  - o Sensor data transmission

7 DESIGNATED USE

The UMRR general purpose medium range radar is suitable for any application where the distance to and relative radial speed of large objects is measured.

Typical applications are:

Robotics: measure shortest distance to obstacle.

Security: detect motions and measure distance to moving object.

Traffic management: detect moving objects, count those, measure speed and measure distance to moving object.

Cranes: measure distance to ground.

Aircraft: measure distance to ground

8 DECLARATION OF CONFORMITY

8.1 DECLARATION OF CONFORMITY FOR USA

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
–Reorient or relocate the receiving antenna.
–Increase the separation between the equipment and receiver .
–Connect the equipment into an outlet on a circuit different from that to which the receiver is connected .
–Consult the dealer or an experienced radio / TV technician for help.

Modifying the device without smartmicro's authorization may result in the device being no longer compliant with FCC requirements. In that event, your right to use the device may be limited by FCC regulations, and you may be required to correct any interference to radio or television communications at your own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the device.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference,
and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
This equipment should be installed and operated with minimum distance 20cm between the radiator &you body.

8.1.1 FCC LABEL

Figure 9: Sample Label for USA

8.2   DECLARATION OF CONFORMITY FOR CANADA

8.2.1   DECLARATION OF CONFORMITY IN ENGLISH

This device complies with Industry Canada license-exempt RSS standard(s).

Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

8.2.2   DÉCLARATION DE CONFORMITÉ EN FRANCAIS

Le present appareil est conforme aux CNR d'Industrie Canada applicables aus appareils radio exempts de licence. Léxploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisaeur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

DÉCLARATION D'EXPOSITION AUX RADIATIONS

This equipment complies with ISEDC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
Cet equipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cetéquipement doit être installé et utilisé avec un minimum de 20cm de distance entre la source de rayonnement et votre corps.

8.2.3 INDUSTRY CANADA (IC) LABEL

Figure 10: Sample Label for Canada

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