Technical Characteristics of the A.D.C. Radar System ARS100-3

Issue 1.0

1. General Description

The A.D.C. automotive radar system for autonomous intelligent cruise control (AICC) and collision warning monitors the traffic area in front of the vehicle using three stationary independent millimeter wave radar beams.

Moving and stationary objects are detected and their distance and relative velocity is measured and processed continuously.

Sixteen times per second the actual traffic situation is analyzed by a digital signal processor within the ECU supplying information to engine control and brake systems in order to operate the vehicle in a distance controlled mode referenced to the relevant object ahead. In case of critical situations a warning can be given to the driver in order to enhance his reaction time.

Due to its physical nature the radar sensor is offering excellent performance characteristics even in adverse weather conditions (fog, rain and snow).

Additional information of vehicle driving conditions is required from standard or specialized in-vehicle sensors, e.g. speed, steering angle and/or yaw rate. This data is made available to the ECU via a universal car network (e.g. CAN) or specific interface circuits.

System hardware configuration is characterized by a two box design with a radar sensor (front end) mounted in the front of the car, typically behind the radiator, and a related Electronic Control Unit in an arbitrary location. Car specific demands and cost issues may lead to a one box solution in the future.

Packaging of the radar frontend is self-contained and the unit is applicable in space critical vehicle environments. The antenna design is based on a monostatic patented reflector arrangement offering optimum mechanical dimensions.

A block diagram of the system is shown in fig.1

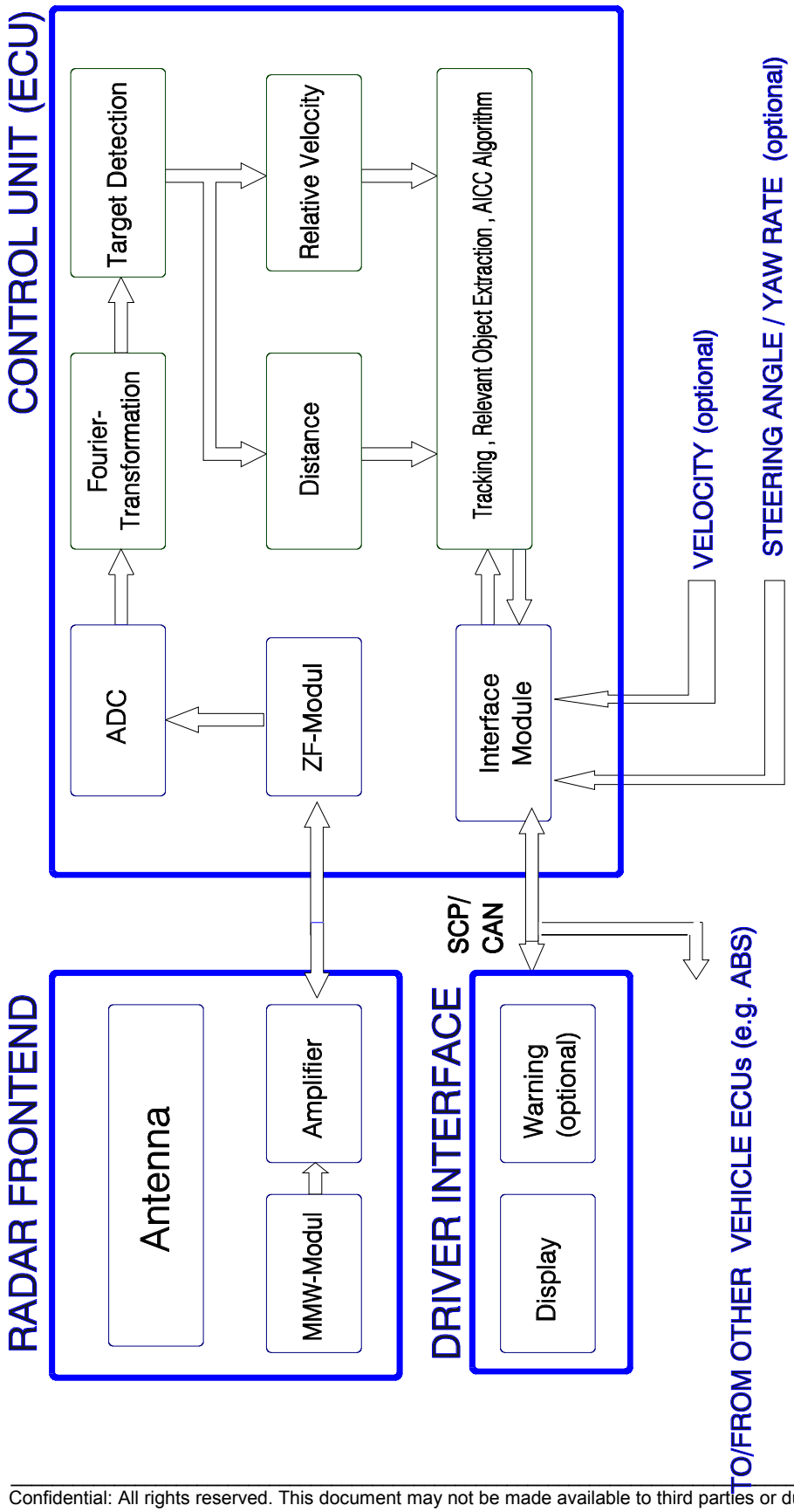


Fig.1 AICC Radar System Functional Block Diagram

2. Technical Charateristics

2.1. System Key Features

Table 1 summarizes technical key features on system level.

Parameter	Value
Operating Frequency	76 ... 77 GHz
Modulation Principle	FM - Pulse Doppler
Average Output Power	200 µW
Beams	three beams with 3.4 ° each
Number of Objects	up to 20
Range	0.5 .... 150 m
Range resolution	1 m (between 7 and 150 m)
Relative velocity	-50 .... 200 km/h
Velocity resolution	1 km/h
Angle Resolution	0.5 °
Processing cycle time	66 ms

Table 1 : Technical Key Features

2.2. Detection Performance

The basic data detection requirement is to measure distance, relative speed, and reflection signal amplitude of moving and stationary objects in three beams. Angular target position is calculated by interpolation algorithms based on signal levels in adjacent beams.

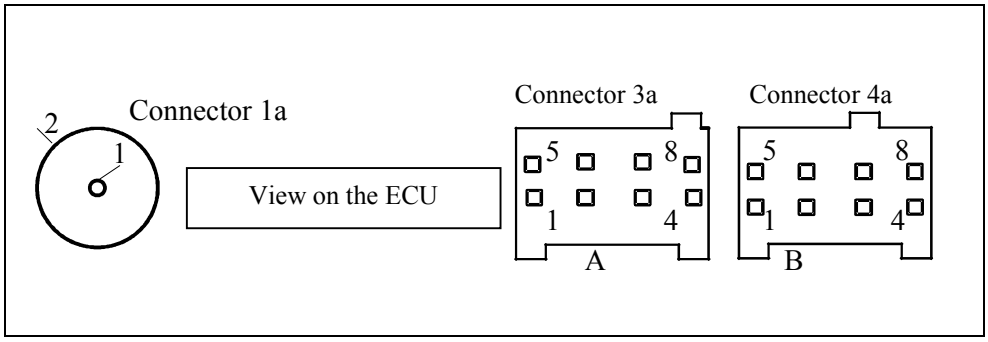
Some technical data of detection performance is summarized in table 2.

Parameter	Value
Antenna beam width azimuth	10.2° (-3dB)
Antenna beam width elevation	3.0° (-3dB)
Range gates	30 per beam , 5m long
Target separation	5 m in longitudinal direction
Multiple target capability	up to 20
Min. detectable radar cross section	100 m : 1 qm² 150 m : 10 qm²
Max. detectable radar cross section	50 ... 150 m: 10000 qm² 5 ... 150 m: 100000 qm² (saturated)

Table 2 : Detection Performance

2.3. Electrical Interfaces

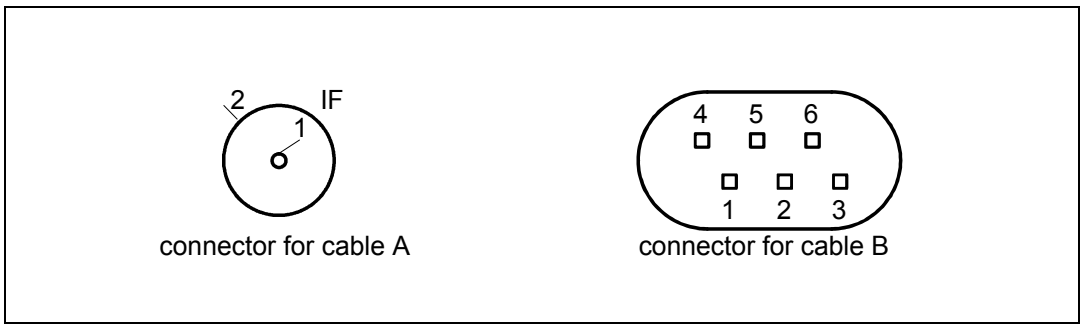
2.3.1. Electronic Control Unit



Operating input voltage:	9 V ... 32 V
Reverse polarity protection :	Yes
Input current :	< 2A
Short circuit protection :	all inputs/output against ground and V_{batt}
Vehicle data interface:	AMP Micro Quadlock (8 pins)
Frontend data interface:	AMP Micro Quadlock (8pins)

2.3.2. Interface Frontend - ECU

Signals between frontend and electronic control unit are transferred via two cables (cable A, cable B). Via cable B additionally the power for the frontend is supplied.



The IF-Signal is transferred from the frontend FE to the electronic control unit ECU.

IF- Signal :	Coaxial (180 MHz) ,
IF-Frequency:	180 MHz ± 20 MHz
IF-Bandwidth:	60 MHz min
IF-impedance:	50 Ohm
IF Return Loss:	- 15 dB max
IF Peak Power:	+10 dBm max
Data Connector	AMP Micro Quadlock (6 pins)
Data (max. baudrate):	30 kBd
Power Supply:	15 V / 0.6 A (generated by ECU)
Ripple on V_{FE}:	100 mV, if C_{FE} > 100µF
Inrush current:	1.0 A max for 1 sec.

2.4. Environmental Conditions

2.4.1. Electronic Control Unit

Operating temperature range:	-25°C ... + 70 °C
Storage temperature range:	-40°C ... + 105 °C (+125°C for 180 min)

2.4.2. Radar Frontend

Operating temperature range:	-25°C ... + 70 °C (full performance)
	+70°C ... + 95 °C (sensor switched off)
Storage temperature range:	-40°C ... + 105 °C (+125°C for 180 min)

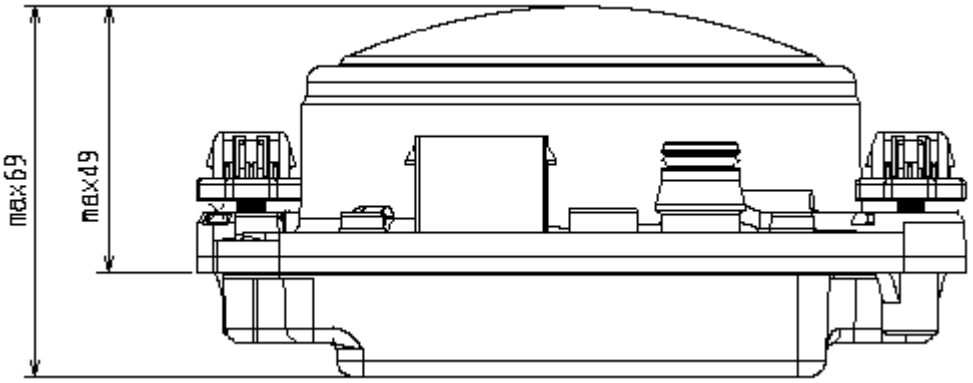
2.5. Self Diagnostic Functions

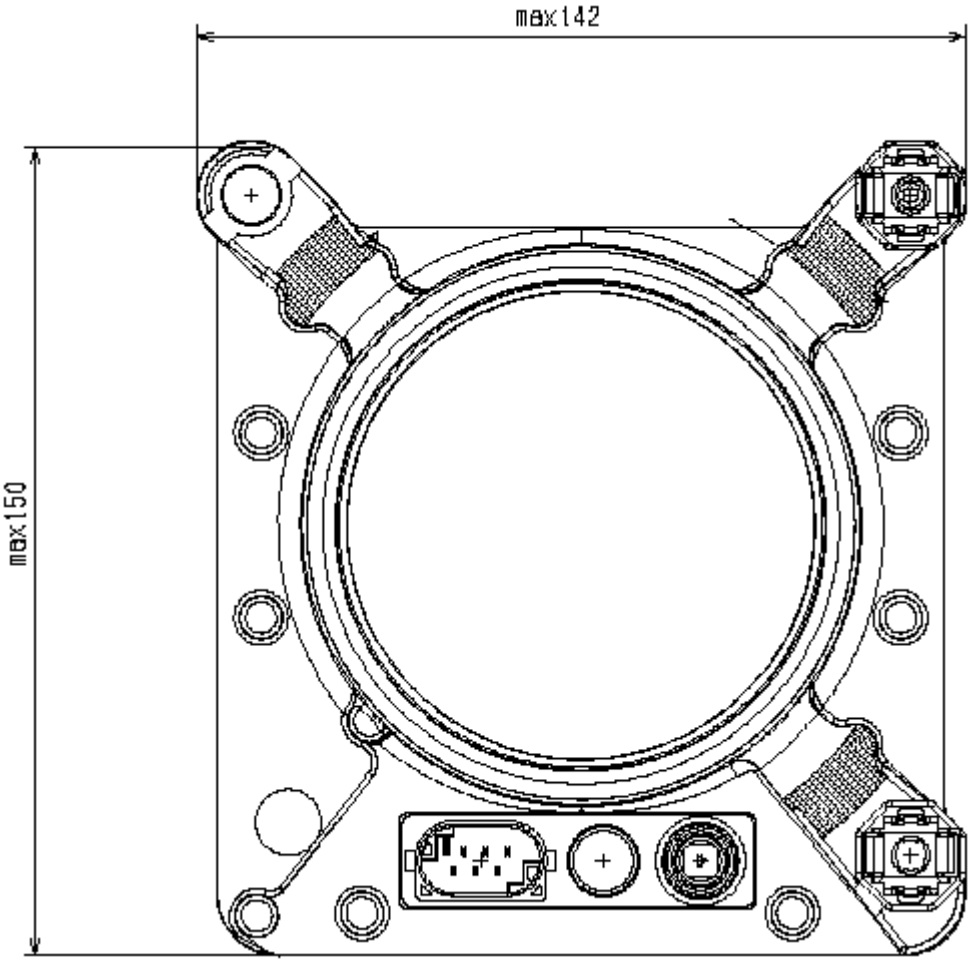
Self diagnostic information is provided via a serial diagnostics interface under following conditions :

- Frontend performance limitations or failures in different categories
- Harness defect between Frontend and ECU in different categories
- ECU internal failures

2.6. Mechanical dimensions

2.6.1. Radar frontend

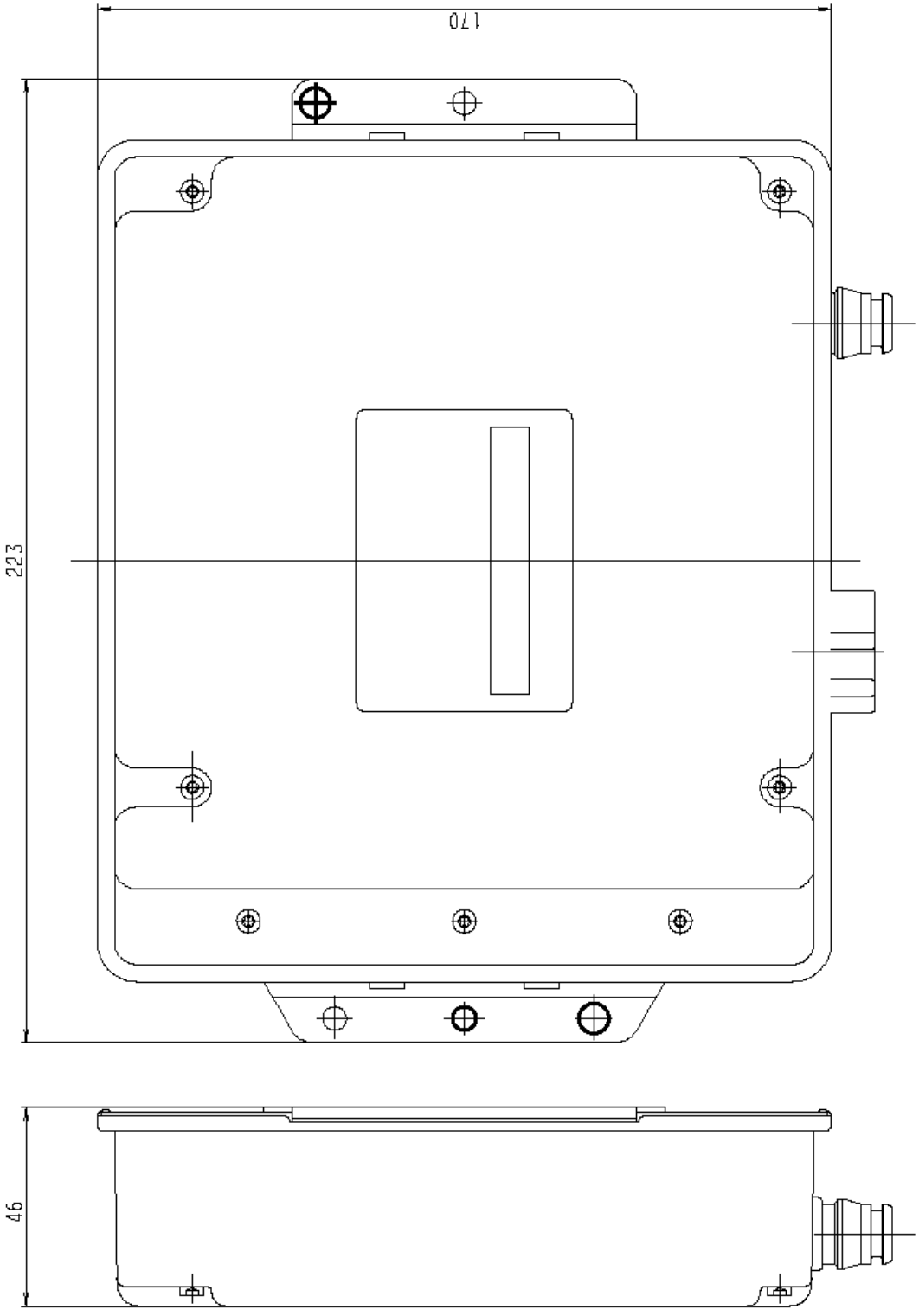


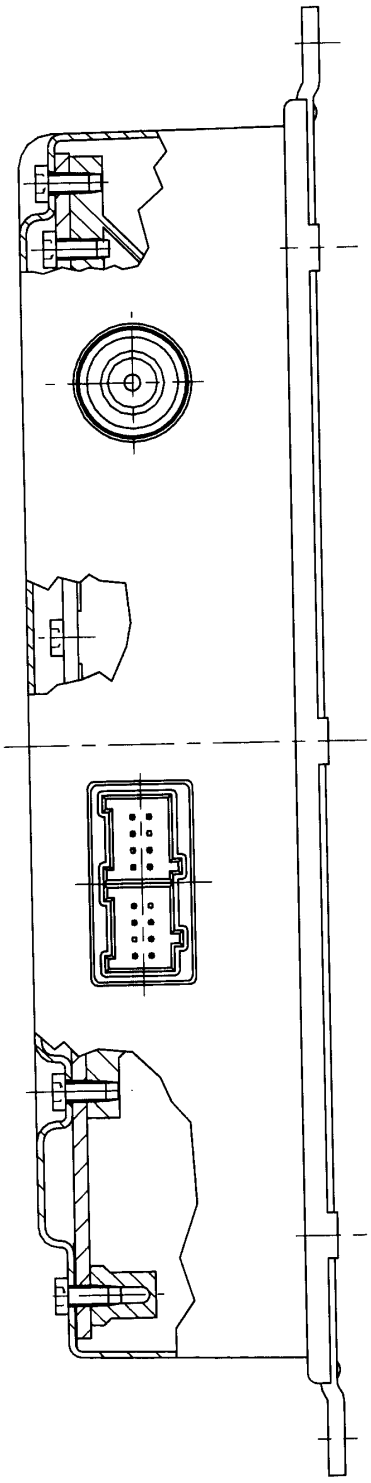


Mechanical dimensions :	
Circular diameter :	100 mm
Height :	70 mm
Outer dimensions :	132 mm x 132 mm (without brackets)
Packaging requirements :	IP 6k9
Weight (typical):	710 gr.

2.6.2. Electronic Control Unit

Mechanical dimensions:	225mm x 195mm x 45mm
Packaging requirements :	IP 6k6
Weight :	885 gr.





Name	Coding	No.	Name	Input/Output	Description
Connector 3a	A	1	GND	Output	Ground reference potential for the sensor
Connector 3a	A	2	DATA-	Bi-directional	Serial interface between control unit and sensor
Connector 3a	A	3			Not utilised
Connector 3a	A	4	VFE-	Output	Negative supply voltage for the sensor
Connector 3a	A	5			Not utilised
Connector 3a	A	6	DATA+	Bi-directional	Serial interface between control unit and sensor
Connector 3a	A	7			Not utilised
Connector 3a	A	8	VFE+	Output	Positive supply voltage for the sensor
Connector 4a	B	1	CANH	Bi-directional	High speed CAN-bus for communication
Connector 4a	B	2	DIAG	Bi-directional	Diagnostic bus (K-line)
Connector 4a	B	3			Not utilised
Connector 4a	B	4	KL87	Input	Positive supply voltage
Connector 4a	B	5	CANL	Bi-directional	High speed CAN-bus for communication
Connector 4a	B	6			Not utilised
Connector 4a	B	7			Not utilised
Connector 4a	B	8	KL31	Input	Negative supply voltage
Connector 1a	IF	1	IF+	Input	180 MHz-intermediate frequency signal
Connector 1a	IF	2	IF-	Input	High frequency grounding connection