Engineering Specification

ES-xxxx-xxxxxx-Ax

PART NAME:	**PART NUMBER:**
AR Hardware Interface Engineering Specification	ES-xxxx-xxxxxx-Ax

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DATE	LET	SECT	REVISION	DR	CK	PREPARED BY:
2021	AA	All	Initial Release			Kevin Grady
						CHECKED BY:
						DETAILED BY:
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						APPROVAL
						DESIGN ENG. SUPERVISOR:
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						OTHER (AS REQUIRED):

STANDARD NOTES:

FOR CURRENT RELEASE STATUS, SEE WERS ENGINEERING NOTICE.

▽**CONTROL ITEM –IDENTIFIES CRITICAL CHARACTERISTICS DESIGNATED BY THE CROSS FUNCTIONAL TEAMS DEVELOPING THE PRODUCT. THESE, AND ADDITIONAL CRITICAL CHARACTERISTICS IDENTIFIED BY PROCESS REVIEWS, MUST APPEAR ON THE CONTROL PLANS ACCORDING TO ISO/TS 16949. THESE CONTROL PLANS REQUIRE PRODUCT ENGINEERING APPROVAL.**

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1   Document overview

This document is the global core Hardware Interface Engineering Specification for Augmented reality electronic modules and sensors. All generic hardware interface engineering requirements related to Augmented reality electronic modules and sensors are detailed.

1.1   Purpose

The information contained herein provides a list of hardware interface engineering requirements for Augmented Reality Electronic Modules supplied to Ford for any vehicle application. Nothing in this specification supersedes applicable laws and regulations unless a specific exemption has been obtained. A general specification hierarchy cannot be created between this Hardware Interface Specification, feature Functional Specification, other component Hardware Specifications and SDS's. In the event of a conflict, the team must review and determine the proper course of action. Where applicable, a specification hierarchy is defined in this specification.

1.2   Document Conventions

1.2.1   Shall, Should, May Definition

This document contains both explanatory text and explicit requirements. The word "shall" denotes a mandatory design requirement. The word "should" denotes a recommended design requirement. The word "may" denotes an optional design requirement.

1.2.2   Requirement Traceability

Each requirement in this document shall be denoted with a hierarchical number. Each requirement has a unique number.

1.2.3   AR Electronic Unit Definition

This document shall refer to AR electronic unit as any AR system component containing any electronic component including all AR ECUs and sensor modules.

1.2.4   Ford FSMS Requirement References

This document shall refer to Ford FSMS requirements. Each FSMS requirement has a unique number and revision. The FSMS requirement format is RQT-xxxxxx-yyyyyy/zz where xxxxxx is the authoring CPSC code; yyyyyy is a serial number; zz is the revision number.

1.3   Reference Documents

1.3.1   SWITCH SDS

1.3.2   ELCOMP SDS

1.4   Definitions

AR – Augmented reality
DAT Electronic Unit – Driver Assist Technology electronic unit including all DAT ECUs and DAT sensors
ECU – Electronic Control Unit
FIR – Far infrared camera
FMC – Ford Motor Company

CONN – Connector
ELCOMP – Electronic Component
ES – Engineering Specification
FPD Link – Flat Panel Display Link
PoC – Power over Coax

2 Interface Requirements

2.1 AR ECU Camera Interface Requirements

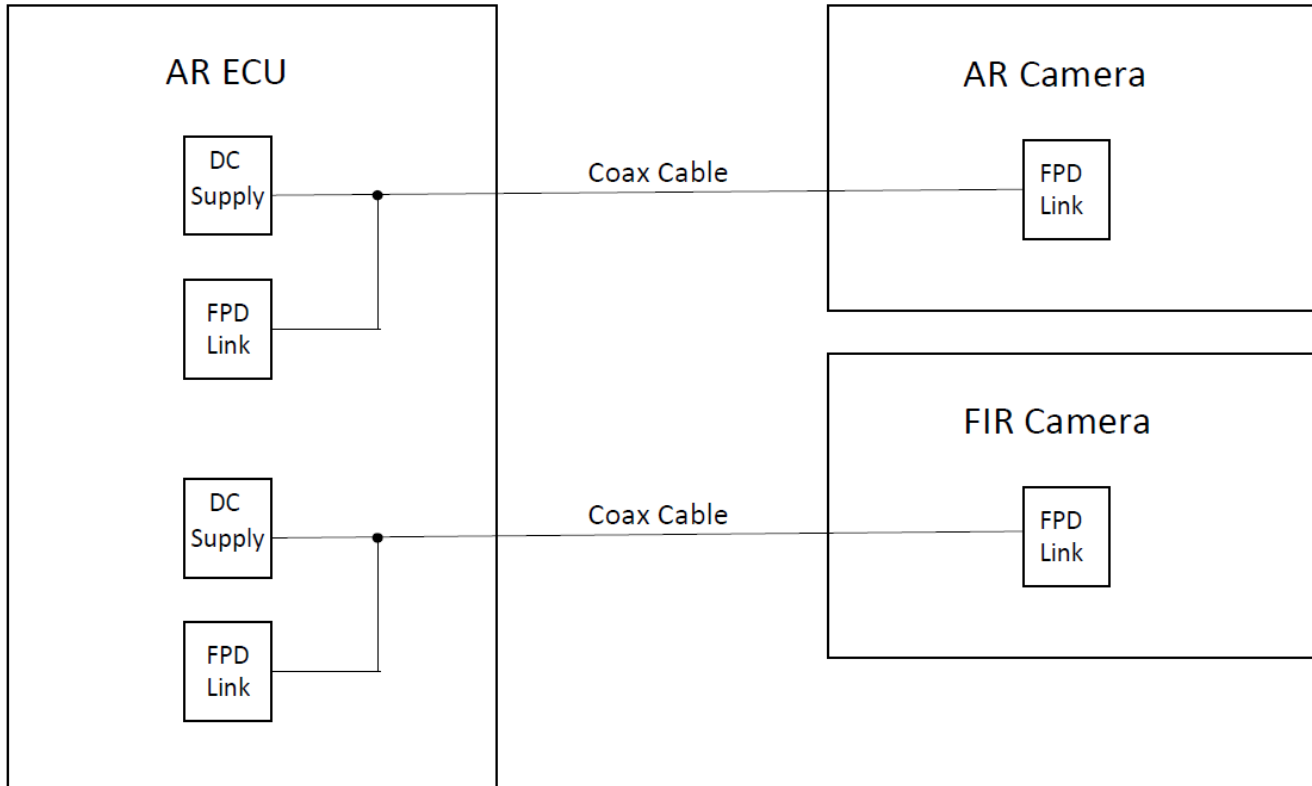### 2.1.1 AR ECU/Camera Interface Diagram

Figure 1 – AR ECU/Camera Interface Diagram

2.1.2 AR Camera Component Requirements

2.1.2.1 The AR Camera component shall be designed with a Ford approved coax connector for FPD Link applications.

2.1.2.2 The AR Camera component shall use a Ford approved FPD Link serializer.

2.1.2.3 The AR Camera component shall meet the FPD Link electrical requirements as detailed in RQT-000601-023124.

2.1.2.4 The AR Camera component shall draw less than or equal to 2.1W.

2.1.2.5 The AR Camera component shall meet performance requirements for input voltage from 6V to 13V as measured at the AR Camera I/O connector.

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2.1.2.6 The AR Camera component shall use an image sensor with a minimum 2Mpixels (resolution of 1920x1080).

2.1.2.7 The AR Camera component shall be capable of 30 frames/s video.

2.1.2.8 The AR Camera component shall configure the FPD Link serializer for synchronous mode.

2.1.2.9 The AR Camera component shall configure the FPD Link serializer for 0x30 (8bit) I2C address.

2.1.2.10 The AR Camera component shall configure the video imager for 0x1A (7bit) I2C address.

2.1.2.11 The AR Camera component shall configure PWL12 (Piece wise Linear compressed 12 bit Output).

2.1.2.12 The AR Camera component shall utilize 25MHz of clock input.

2.1.3   FIR Camera Component Requirements

2.1.3.1 The FIR Camera component shall be designed with a Ford approved coax connector for FPD Link applications.

2.1.3.2 The FIR Camera component shall use a Ford approved FPD Link serializer.

2.1.3.3 The FIR Camera component shall meet the FPD Link electrical requirements as detailed in RQT-000601-023124.

2.1.3.4 The FIR Camera component shall draw less than or equal to 5W.

2.1.3.5 The FIR Camera component shall meet performance requirements for input voltage from 6V to 19V as measured at the FIR Camera I/O connector.

2.1.3.6 The FIR camera component shall isolate attachment points to the vehicle and eliminate ground loops to the vehicle in case of case ground design.

2.1.3.7 The FIR Camera component shall use an image sensor with a minimum 230.4kpixels (resolution of 640x368).

2.1.3.8 The FIR Camera component shall be capable of 30 frames/s video.

2.1.3.9 The FIR Camera component shall configure the FPD Link serializer for synchronous mode.

2.1.3.10 The FIR Camera component shall configure the FPD Link serializer for 0x30/0x18 (8bit/7bit) I2C address.

2.1.3.11 The FIR Camera component shall configure the embedded CPU controlled ISP chip for 0xE0/0x70 (8bit/7bit) I2C address.

2.1.3.12 The FIR Camera component shall output two video streams in CSI-2 RAW8 and RAW14 format.

2.1.3.13 The FIR Camera component shall utilize Challenge Handshake Authentication Protocol (CHAP) to form secure connection with AR ECU.

2.1.3.14 The FIR Camera component shall complete initial CHAP at power up within 750(+/-30%) msec.

2.1.4 AR ECU Requirements

2.1.4.1 The AR ECU shall be designed with a Ford approved coax connector for the FPD Link applications.

2.1.4.2 The AR ECU shall use a Ford approved FPD Link de-serializer.

2.1.4.3 The AR ECU shall meet the electrical FPD Link requirements in RQT-000601-023124.

2.1.4.4 The AR ECU shall be capable of delivering 2.1W to the AR Camera component as measured at the AR camera component.

2.1.4.5 The AR ECU shall be capable of delivering 5W to the FIR Camera component as measured at the FIR camera component.

2.1.4.6 The AR ECU shall deliver a DC regulated voltage as measured at the AR ECU connector I/O to meet the requirement in 2.1.2.5 and 2.1.3.5. The AR ECU shall assume 14m of RTK-031 for worst case DC wiring voltage drop (the 14m coax length is a recommendation).

2.1.4.7 The AR ECU shall meet the output protection requirements in RQT-191001-009853.

2.1.4.8 The AR ECU shall meet the output short circuit protection requirements in RQT-191001-009855.

2.1.4.9 The AR ECU shall meet the output diagnostic detection capability requirements in RQT-191001-009856.

2.1.4.10 The AR ECU shall configure 24 bit Dynamic range for AR camera.

2.1.4.11 The AR ECU shall configure 25MHz of clock input to AR camera.

2.1.4.12 The AR ECU shall utilize 12 bit RAW data from AR camera to feed to ISP on ECU for image quality tuning for AR camera.

2.1.4.13 The AR ECU shall configure MIPI CSI-2 data rate per recommendation from image sensor supplier for AR camera. The current recommendation is 222.75MHz.

2.1.4.14 The AR ECU shall utilize Challenge Handshake Authentication Protocol (CHAP) to form secure connection with FIR Camera.

2.1.4.15 The AR ECU shall complete initial CHAP at power up within 750(+/-30%) msec.

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2.1.4.16 The AR ECU shall allocate computation resource (size TBD) to integrate FIR Camera supplier software in case of image quality optimization support required from AR ECU.

2.1.4.17 The AR ECU shall configure FIR Camera as detailed in FIR Camera supplier communication protocol specification (to be obtained via sourced supplier). This includes, but not limit to, Serializer Configuration Registers, Serializer Status Registers, Video Stream Configuration.

3   Revision History

3.1   Revision Change Log

Revision	Date	Author	Section	Description
AA	April 2021	Kevin Grady	all	Initial release

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