



Research & Vehicle Technology
“Infotainment Systems Product Development”

**Feature – I2C over LVDS Communication
Protocol**

Version 1.8

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Version Date: October 4, 2018

FORD CONFIDENTIAL



Revision History

Date	Version	Notes	
April 20, 2015	1.0	Initial Release	
December 9, 2015	1.1	Updated Release	
	IFS-MMI2C-SR-REQ-140544/B-System Overview	<joravec4> Improve documentation. Move requirements into separate lines. No technical change.	
	IFS-MMI2C-SR-REQ-199141/A-Bus Frequency	<joravec4> Split requirement into a separate line. Formerly in REQ-140544	
	IFS-MMI2C-SR-REQ-199142/A-Slave Addresses	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140544	
	IFS-MMI2C-SR-REQ-199146/A-Clock Stretching	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140544	
	IFS-MMI2C-SR-REQ-140545/B-Supported Displays	<joravec4> Eliminate SDM12 (doesn't exist, yet)	
	IFS-MMI2C-SR-REQ-140552/B-Display Microcontroller	<joravec4> Moved requirement here from REQ-140544	
	IFS-MMI2C-SR-REQ-140551/B-Touch and Calibration	<joravec4> Clarify requirements for portrait orientation	
	IFS-MMI2C-SR-REQ-202034/A-Signal Limit Threshold	<joravec4> Clarify responsibility to define threshold for diagnostic	
	IFS-MMI2C-SR-REQ-140554/B-Timer Settings	<joravec4> Relax enable / disable to 200 ms for JDI	
	IFS-MMI2C-SR-REQ-199145/A-Time to Ready	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140544	
	STR-302638/A-Diagnostics	<joravec4> Remove REQ-199356. Not applicable for capacitive touch	
	IFS-MMI2C-SR-REQ-199349/A-Invalid Atmel User Data (Gen1)	<joravec4> Improve documentation, explain method to diagnose and actions to take. No technical change.	
	IFS-MMI2C-SR-REQ-199350/A-Unsupported Display (Gen2)	<joravec4> Improve documentation, explain method to diagnose and actions to take. No technical change.	
	IFS-MMI2C-SR-REQ-197882/A-Unexpected Reset	<joravec4> Add diagnostic requirement to monitor INIT bit (REQ-140614) to detect power-cycle and crash/reset.	
	IFS-MMI2C-SR-REQ-197881/A-Reset Request	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140614.	
	IFS-MMI2C-SR-REQ-197883/A-LCD Connection	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140614.	
	IFS-MMI2C-SR-REQ-197885/A-Temperature Derating	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140614.	
	IFS-MMI2C-SR-REQ-197884/A-LCD Backlight	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140614.	
	IFS-MMI2C-SR-REQ-197886/A-LCD Module / Panel	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140614.	
	IFS-MMI2C-SR-REQ-199144/A-Failure to Enable (Gen1)	<joravec4> Split diagnostic requirement into a separate line. Formerly in REQ-140544	
	IFS-MMI2C-SR-REQ-197887/A-Loss of Lock (Gen2)	<joravec4> Add diagnostic requirement to monitor LLOSS bit (REQ-140614) to detect momentary loss-of-lock.	
	IFS-MMI2C-SR-REQ-199353/A-Loss of Communication with Display Microcontroller	<joravec4> Improve documentation, explain method to diagnose and actions to take. No technical change.	
	IFS-MMI2C-SR-REQ-199355/A-Loss of Communication with Touch IC	<joravec4> Improve documentation, explain method to diagnose and actions to take. No technical change.	
	IFS-MMI2C-SR-REQ-199354/A-AVdd Power Test	<joravec4> Improve documentation, explain method to diagnose and actions to take. No technical change.	
	IFS-MMI2C-SR-REQ-199369/A-Pin Fault Test	<joravec4> Improve documentation, explain method to diagnose and actions to take. No technical change.	



IFS-MMI2C-SR-REQ-199370/A-Signal Limit Test	<joravec4> Improve documentation, explain method to diagnose and actions to take. No technical change.
IFS-MMI2C-SR-REQ-197874/A-Interrupt Polling	<joravec4> Add requirement for host to poll, in case of suspected missed / stuck interrupt.
IFS-MMI2C-SR-REQ-199134/A-Restart AEQ Algorithm	<joravec4> Improve documentation, explain requirements of LVDS chipset. No technical change.
IFS-MMI2C-SR-REQ-199143/A-Display Re-Enable (Gen1)	<joravec4> Split requirement into a separate line. Formerly in REQ-140544
IFS-MMI2C-SR-REQ-199348/A-Atomic Transaction	<joravec4> Improve documentation, explain requirements of LVDS chipset. No technical change.
IFS-MMI2C-SR-REQ-199357/A-Avoid driving INTB_IN during loss-of-lock	<joravec4> Improve documentation, explain requirements of LVDS chipset. No technical change.
IFS-MMI2C-FUN-REQ-140573/B-Generation 1 Display Modules	<joravec4> Removed REQ-140594 Touch Controller (Atmel) Message. Superseded by REQ-140577
IFS-MMI2C-SR-REQ-197942/A-Interrupt	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-197934/A-Loss of Lock	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-197944/A-Write to Display Microcontroller	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-197943/A-Read from Display Microcontroller	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-197946/A-Read from Display Microcontroller Beyond Defined Length	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140589/B-Display Status Message - Legacy	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140595/B-0x01 LCD Backlight PWM Value	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140596/B-0x02 Display Scanning	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140597/B-0x03 Display Enable	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140600/B-0x04 Display Shutdown	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-197941/A-Interrupt Request	<joravec4> Improve documentation, explain INTB_IN is edge-triggered. Change design so interrupt request is triggered by an event, instead of a level.
STR-307933/A-Single IC driving INTB_IN	<joravec4> Improve documentation. No technical change.
STR-307934/A-Multiple ICs driving INTB_IN	<joravec4> Improve documentation. No technical change.
STR-307941/A-Interrupt Request Strategy	<joravec4> Improve documentation, explain requirements of LVDS chipset. No technical change.
IFS-MMI2C-SR-REQ-198936/A-Interrupt Service	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-197933/A-Loss of Lock	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140564/B-Write to Subaddress	<joravec4> Improve example. No technical change.
IFS-MMI2C-SR-REQ-140561/B-Read from Subaddress	<joravec4> Improve example. Change requirement to echo subaddress. Remove requirement for repeated-start.
IFS-MMI2C-SR-REQ-197857/A-Write to Read-Only Subaddress	<joravec4> Improve example. Remote requirement to NAK invalid bytes.
IFS-MMI2C-SR-REQ-140569/B-Write Underflow	<joravec4> Improve example. Remove requirement to NAK.



IFS-MMI2C-SR-REQ-140570/B-Write Overflow	<joravec4> Improve example. Remove requirement to NAK invalid bytes.
IFS-MMI2C-SR-REQ-197875/A-Read from Subaddress Beyond Defined Length	<joravec4> Split from REQ-140561 as separate requirement. Improve example.
IFS-MMI2C-SR-REQ-140565/B-Undefined / Unsupported Subaddress	<joravec4> Improve example. Remove requirement to NAK invalid bytes.
IFS-MMI2C-SR-REQ-140566/B-Reserved Bits	<joravec4> Improve example. Change requirement from NAK to "don't care" for reserved bits.
IFS-MMI2C-SR-REQ-140614/B-0x00 Display Status	<joravec4> Add bit "LVDS Loss of Lock Occurred" Add bit "Display Initialized"
IFS-MMI2C-SR-REQ-140615/B-0x01 Display Identification	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140616/B-Display Identification Table	<joravec4> Correct typo on Atmel 641T IC
IFS-MMI2C-SR-REQ-140617/B-0x02 LCD Backlight PWM Value	<joravec4> Eliminate invalid bit.
IFS-MMI2C-SR-REQ-140618/B-0x03 Display Scanning	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140619/B-0x04 Display Enable	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140620/B-0x05 Display Shutdown	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140621/B-0x06 Button Backlight PWM Value	<joravec4> Eliminate invalid bit.
IFS-MMI2C-SR-REQ-140622/B-0x07 Button Status	<joravec4> Improve documentation. No technical change.
IFS-MMI2C-SR-REQ-140623/B-0x30 Interrupt Status Register	<joravec4> Add touch interrupt. Change to edge-triggering behavior: clear on reading ISR, set on any event.
IFS-MMI2C-SR-REQ-140624/B-0x31 Core Assembly FPN	<joravec4> Improve documentation. If unsupported return 0xFF's, as required in REQ-140565.
IFS-MMI2C-SR-REQ-140625/B-0x32 Delivery Assembly FPN	<joravec4> Improve documentation. If unsupported return 0xFF's, as required in REQ-140565.
IFS-MMI2C-SR-REQ-140626/B-0x33 Software FPN	<joravec4> Improve documentation. If unsupported return 0xFF's, as required in REQ-140565.
IFS-MMI2C-SR-REQ-140627/B-0x34 Serial Number	<joravec4> Improve documentation. If unsupported return 0xFF's, as required in REQ-140565.
IFS-MMI2C-SR-REQ-140628/B-0x35 Main Calibration Data FPN	<joravec4> Improve documentation. If unsupported return 0xFF's, as required in REQ-140565.

July 12, 2016	1.2	Updated Release	
	IFS-MMI2C-SR-REQ-140547/B-Identifying Connected Display	<joravec4> Change Gen1 default, when T38 is invalid, to Sharp DM8	
	IFS-MMI2C-SR-REQ-226922/A-Write Configuration to Flash	<joravec4> Add requirement to support recovery if power is not maintained during BACKUPNV operation	
	IFS-MMI2C-SR-REQ-140577/B-Display Identifier - Legacy	<joravec4> Add requirement to support for MY18 Sharp DM8 with Shoei touch panel	
November 3, 2016	1.3	Updated Release	
	IFS-MMI2C-SR-REQ-140616/C-Display Identification Table	<joravec4> Add new displays: 0x07, 0x08, 0x09, 0x0A	
December 12, 2016	1.4	Updated Release	
	IFS-MMI2C-SR-REQ-140616/D-Display Identification Table	<joravec4> Add support for displays 0x0B, 0x0C	



August 24, 2017			
1.5	Updated Release		
	IFS-MMI2C-FUN-REQ-140540/B-I2C Interface Displays		<hzubert> renamed added "Displays"
	IFS-MMI2C-SR-REQ-140544/C-System Overview Displays		<hzubert> renamed added "Displays"
	IFS-MMI2C-SR-REQ-199141/B-Bus Frequency		<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-199142/B-Slave Addresses		<hzubert> added addresses for Camera; <joravec4> added addresses for Cypress display
	IFS-MMI2C-SR-REQ-199146/B-Clock Stretching		<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-140571/B-Device Drivers		<joravec4> Improve documentation. No technical change.
	IFS-MMI2C-SR-REQ-140554/C-Timer Settings		<hzubert> generalized tDM_RESET and tSDM_RESET to tLVDSSlave_RESET; no technical change
	IFS-MMI2C-SR-REQ-199145/B-Time to Ready		<hzubert> Generalized wording
	STR-302638/B-Diagnostics		<joravec4> Replace U0162-01 with U0162-00 per jvanhou2 request; <hzubert> added name column for generalizing requirements; added REQ-266614, REQ-266615, REQ-266616 for Cypress Touch Controllers per jdippel request
	IFS-MMI2C-SR-REQ-197882/B-Unexpected Reset		<hzubert> Generalized wording and DTC and DID values
	IFS-MMI2C-SR-REQ-197881/B-Reset Request		<hzubert> Generalized wording and DTC and DID values
	IFS-MMI2C-SR-REQ-199371/B-LVDS Link Detect Fault+		<joravec4> Replace U0162-01 with U0162-00 per jvanhou2 request <hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-199371/C-LVDS Link Detect Fault		<hzubert> Generalized wording and DTC and DID values
	IFS-MMI2C-SR-REQ-197887/B-Loss of Lock (Gen2)		<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-199354/B-AVdd Power Test (Atmel-only)		<hzubert> added "(Atmel-only)" in name
	IFS-MMI2C-SR-REQ-266614/A-AVdd Power Test (Cypress-only)		<hzubert> initial release
	IFS-MMI2C-SR-REQ-199369/B-Pin Fault Test (Atmel-only)		<hzubert> added "(Atmel-only)" in name
	IFS-MMI2C-SR-REQ-266615/A-Pin Fault Test (Cypress-only)		<hzubert> initial release
	IFS-MMI2C-SR-REQ-199370/B-Signal Limit Test (Atmel-only)		<hzubert> added "(Atmel-only)" in name
	IFS-MMI2C-SR-REQ-266616/A-Signal Limit Test (Cypress-only)		<hzubert> initial release
	IFS-MMI2C-SR-REQ-202030/B-Reset Request		<hzubert> generalized tSDM_RESET to tLVDSSlave_RESET; no technical change
	IFS-MMI2C-SR-REQ-202033/B-Loss of Communication		<hzubert> generalized tDM_RESET to tLVDSSlave_RESET; no technical change
	IFS-MMI2C-SR-REQ-199134/B-Restart AEQ Algorithm		<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-199348/B-Atomic Transaction		<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-261350/A-Atmel Touch IC Maximum Resets		<joravec4> New requirement
	IFS-MMI2C-SR-REQ-197941/B-Interrupt Request		<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-197933/B-Loss of Lock Displays		<hzubert> renamed added "Displays"
	IFS-MMI2C-SR-REQ-140564/C-Write to Subaddress		<hzubert> Generalized wording and diagram example
	IFS-MMI2C-SR-REQ-140561/C-Read from Subaddress		<hzubert> Generalized wording and diagram example
	IFS-MMI2C-SR-REQ-197857/B-Write to Read-Only Subaddress		<hzubert> Generalized wording and diagram example
	IFS-MMI2C-SR-REQ-140569/C-Write Underflow		<hzubert> Generalized wording and diagram example
	IFS-MMI2C-SR-REQ-140570/C-Write Overflow		<hzubert> Generalized wording and diagram example
	IFS-MMI2C-SR-REQ-197875/B-Read from Subaddress Beyond Defined Length		<hzubert> Generalized wording and diagram example



	IFS-MMI2C-SR-REQ-140565/C-Undefined / Unsupported Subaddress	<hzubert> Generalized wording and diagram example
	IFS-MMI2C-SR-REQ-140611/C-Reserved Bits	<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-140566/C-Reserved Bits	<hzubert> Generalized wording and diagram example
	IFS-MMI2C-SR-REQ-140616/E-Display Identification Table	<hzubert> Add new display IDs: 0x0d, 0x0e, 0x0f, 0x10
	IFS-MMI2C-SR-REQ-140624/C-0x31 Core Assembly FPN	<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-140625/C-0x32 Delivery Assembly FPN	<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-140626/C-0x33 Software FPN	<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-140627/C-0x34 Serial Number	<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-140628/C-0x35 Main Calibration Data FPN	<hzubert> Generalized wording
	STR-207235/B-Appendix A: Definitions / Acronyms	<hzubert> added description for Gen2 Cameras and IPMB
	STR-207171/B-Appendix B: Reference Documents	<hzubert> added Cypress Touch Controller Technical Reference
February 2, 2018	1.6	Updated Release
	IFS-MMI2C-SR-REQ-199142/C-Slave Addresses	<hzubert> added new de/serializer series 94x; added new touch controller support (replaced CYAT81 by CYAT8268x, added S7880, mxT1067T)
	IFS-MMI2C-SR-REQ-140545/C-Supported Displays	<hzubert> added new displays (Sharp VDM8, Sharp SDM12, JDI SDM8)
	IFS-MMI2C-SR-REQ-140616/F-Display Identification Table	<hzubert> exchanged S7881 with S7880; added SDM12
August 7, 2018	1.7	Updated Release
	IFS-MMI2C-SR-REQ-199142/D-Slave Addresses	<hzubert> added IPC and HUDs; added UHxyz serializers
	IFS-MMI2C-SR-REQ-140545/D-Supported Displays	<hzubert> added DM12, SDM15, IPC and HUDs
	IFS-MMI2C-SR-REQ-140547/C-Identifying Connected Display	<hzubert> added IPC and HUD;generalized wording
	IFS-MMI2C-FUN-REQ-140607/B-Generation 2 Display Modules	<hzubert> added below I2C Messages 0x40-0x46,0x91,0x92
	STR-207381/B-I2C Messages	<hzubert> added 0x40-0x46,0x91,0x92
	IFS-MMI2C-SR-REQ-140615/C-0x01 Display Identification	<hzubert> added subrevision
	IFS-MMI2C-SR-REQ-140616/G-Display Identification Table	<hzubert> TC update for 0x0D and 0x10; added support DM12, SDM15, IPC and HUDs up to 0x19; added column for illumination strategy
	IFS-MMI2C-SR-REQ-140619/C-0x04 Display Enable	<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-140620/C-0x05 Display Shutdown	<hzubert> Generalized wording
	IFS-MMI2C-SR-REQ-307237/A-0x40 Image Adjustment	<hzubert> initial release
	IFS-MMI2C-SR-REQ-306750/A-0x41 Supplier Precalc Low Warping Table	<hzubert> initial release
	IFS-MMI2C-SR-REQ-307232/A-0x42 Supplier Precalc Medium Warping Table	<hzubert> initial release
	IFS-MMI2C-SR-REQ-307233/A-0x43 Supplier Precalc High Warping Table	<hzubert> initial release
	IFS-MMI2C-SR-REQ-307234/A-0x44 Supplier EOL Low Warping Table	<hzubert> initial release
	IFS-MMI2C-SR-REQ-307235/A-0x45 Supplier EOL Medium Warping Table	<hzubert> initial release
	IFS-MMI2C-SR-REQ-307236/A-0x46 Supplier EOL High Warping Table	<hzubert> initial release
	IFS-MMI2C-SR-REQ-323568/A-0x91 Light Ambient Sensor RAW Value	<hzubert> initial release
	IFS-MMI2C-SR-REQ-324467/A-0x92 Forward Collision Warning Status	<hzubert> initial release
	STR-207235/C-Appendix A: Definitions / Acronyms	<hzubert> added HUD, IPC, DMD, TFT



	STR-207171/C-Appendix B: Reference Documents	<hzubert> Generalized wording for hardware spec
October 4, 2018	1.8	Updated Release
	IFS-MMI2C-SR-REQ-140544/D-System Overview Displays	<hzubert> added Rotary
	IFS-MMI2C-SR-REQ-140545/E-Supported Displays	<hzubert> added MD23
	IFS-MMI2C-SR-REQ-140549/B-Device Driver	<hzubert> added Rotary Input
	IFS-MMI2C-FUN-REQ-140607/B-Generation 2 Display Modules+	<hzubert> added below I2C Messages 0x40-0x46,0x91,0x92
	IFS-MMI2C-FUN-REQ-140607/C-Generation 2 Display Modules	<hzubert> added Rotary
	STR-307924/B-Interrupt	<hzubert> added Rotary
	IFS-MMI2C-SR-REQ-198936/B-Interrupt Service	<hzubert> added Rotary
	STR-207381/C-I2C Messages	<hzubert> added 0x08 Rotary Satus
	IFS-MMI2C-SR-REQ-140614/C-0x00 Display Status	<hzubert> added TCERR and TSCERR;corrected text format;corrected description for RST_RQ
	IFS-MMI2C-SR-REQ-140615/C-0x01 Display Identification	<hzubert> added subrevision
	IFS-MMI2C-SR-REQ-140616/H-Display Identification Table	<hzubert> added rotary column (Rtr);added 0x1A,0x1B,0x1C and 0xFD,0xFE; reduced length of word like Orientation -> Orient.; Display Identifier -> Display ID;Landscape -> Landscp.;Display -> Disp.; added "e.g." to note
	IFS-MMI2C-SR-REQ-140623/C-0x30 Interrupt Status Register	<hzubert> added interrupt for rotary;corrected text format



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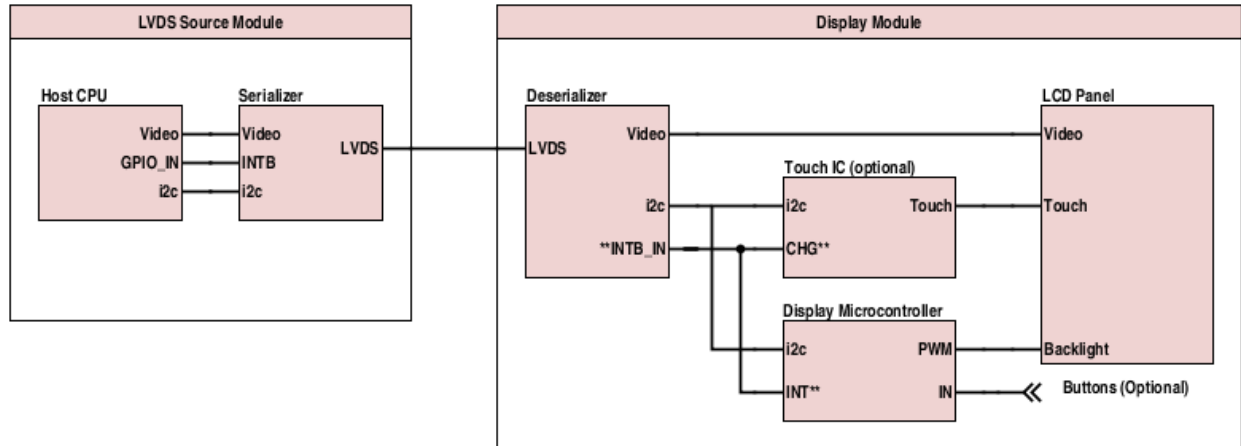
1 General Requirements

2 Functional Definition

2.1 IFS-MMI2C-FUN-REQ-140540/B-I2C Interface Displays

2.1.1 IFS-MMI2C-SR-REQ-140544/D-System Overview Displays

The LVDS interface block diagram looks like:



** Interrupt architecture varies by display

The LVDS Source Module contains:

- Host CPU, which acts as an I²C bus master
- LVDS Serializer IC

The Display Module contains:

- LVDS Deserializer IC
- Display Microcontroller, which acts as an I²C slave
- LCD Panel
- Touch IC (optional), which acts as an I²C slave
- Buttons (optional)
- Rotary (optional)

2.1.2 IFS-MMI2C-SR-REQ-199141/B-Bus Frequency

The I²C Master shall support a bus frequency of 400 kHz. All peripherals on the I²C Slave shall support a bus frequency of 400 kHz.

The I²C Master may configure the deserializer for, and operate at, any bitrate that meets overall system performance requirements. Refer to the TI user's guide for details on configuring the deserializer bitrate with "SCL High Time" and "SCL Low Time".

Note: Even if both sides use 400 kHz, the LVDS link has a lower effective-bitrate (~163 kHz) because each byte is buffered and regenerated. Refer to TI AN-2173 for a table of achievable net bitrates.

2.1.3 IFS-MMI2C-SR-REQ-199142/D-Slave Addresses

The following I²C Slave addresses shall be used (7 bit format):



Device	Generation 1 Displays	Generation 2 / IPC / HUD Displays	Generation 2 Cameras
Serializer (92x series)	0x15	0x15	0x5D
Serializer (UH92x series)	---	0x0C	---
Serializer (UH94x series)	---	0x0C	---
Deserializer (92x series)	0x35	0x35	0x30
Deserializer (94x series)	---	0x34	---
Touch Screen Controller (mXT641T)	---	0x4B	---
Touch Screen Controller (mXT449T)	---	0x4B	---
Touch Screen Controller (mXT1188S)	---	0x4A	---
Touch Screen Controller (mXT540E)	0x4D	---	---
Touch Screen Controller (mxT1067T)	---	0x4B	---
Touch Screen Controller (CYAT8268x)	---	0x24	---
Touch Screen Controller (S7880)	---	0x20	---
Slave Microcontroller	0x70	0x71	0x5E

I²C Slave shall not respond on any other slave address. All unspecified addresses are reserved for future expansion.

2.1.4 IFS-MMI2C-SR-REQ-199146/B-Clock Stretching

The I²C Master shall support clock stretching as defined by the I²C specification.

The I²C Slave shall not stretch the clock for longer than 500 microseconds at a time.

2.1.5 IFS-MMI2C-SR-REQ-140545/E-Supported Displays

The LVDS Source Module shall support the following displays:

Interface	Description
Gen1	Sharp DM8
Gen1	Visteon DM6
Gen1	Visteon DM8
Gen2	Visteon SDM4
Gen2	Sharp SDM6
Gen2	Sharp SDM8
Gen2	Sharp VDM8
Gen2	Sharp SDM12
Gen2	Sharp DM12
Gen2	JDI SDM8
Gen2	JDI SDM10
Gen2	Preh SDM15
Gen2	DMD HUD0.3
Gen2	DMD HUD0.6
Gen2	TFT HUD2
Gen2	TFT HUD3
Gen2	IPC12
Gen2	MD23

The LVDS Source Module must have a device driver and calibration file for each supported display.

2.1.6 IFS-MMI2C-SR-REQ-140571/B-Device Drivers

LVDS Source module shall consider the dynamically-detected display module type, and load the correct device drivers for:

- Video Output
- Touch Input
- Display Control (backlight, status, etc)



For displays containing Atmel chipset, the LVDS Source module shall implement a software device driver based on the `atmel_mxt_ts` driver published by Atmel at <https://github.com/atmel-maxtouch/linux>. The driver must support all features of Atmel `maXTouch E`, `S`, and `T` series chips. The driver must support loading touch calibration in `*.xcfg` or `OBP_RAW` format. LVDS Source module shall implement Atmel's `mxt-app` published at <https://github.com/atmel-maxtouch/obp-utils>

2.1.7 IFS-MMI2C-SR-REQ-140549/B-Device Driver

LVDS Source Module shall consider the dynamically-detected display module type, and load the correct device drivers for:

- Video Output
- Touch Input (as applicable)
- Button Input (as applicable)
- Rotary Input (as applicable)
- Display Control (backlight, status, etc)

2.1.8 IFS-MMI2C-SR-REQ-140552/B-Display Microcontroller

The display microcontroller shall support the power up / power down requirements of the TSC. The display microcontroller shall provide the proper power sequencing and reset line controls for the TSC to power up / power down properly. The display microcontroller shall use the timing requirements of the TSC to determine that the TSC is ready.

The display microcontroller shall be robust to abrupt power removal.

The display microcontroller shall not update any data accessible over the I²C interface while an I²C access is in progress. An I²C access is bounded by the START and STOP states as defined by the I²C specification.

2.1.9 Touch

2.1.9.1 IFS-MMI2C-SR-REQ-140560/A-Touch Screen Pixel Mapping

Display shall be calibrated such that touch coordinates and display pixels have a 1:1 mapping.

2.1.9.2 IFS-MMI2C-SR-REQ-140551/B-Touch and Calibration

For a landscape display, the system shall be designed such that LCD [0,0] and Touch [0,0] are both in the top-left corner when viewed by the driver. This means that:

- LCD displays the video signal as top-to-bottom and left-to-right
- Touch is calibrated such that [0,0] is in the top-left corner

For a portrait display, the system shall be designed such that LCD [0,0] is in the bottom-left corner and Touch [0,0] is in the top-left corner when viewed by the driver. This means that:

- LCD is rotated counter-clockwise (-90 degrees) from the landscape orientation
- Touch is calibrated such that [0,0] is in the top-left corner

In both cases the display shall be responsible to control the direction of video (using HRV / VRV), based on the final orientation when installed in a vehicle.

2.1.9.3 **Atmel Touch Controllers**

2.1.9.3.1 IFS-MMI2C-SR-REQ-140556/B-Touch Screen Calibration (Atmel E-Series)

The display supplier shall calibrate:

- T9 instance 0 enabled



- T27 pinch, stretch enabled

The LVDS Source Module shall utilize these touch objects for single-touch and multi-touch detection.

The display supplier may utilize any other features to provide robust touch-detection. The LVDS Source module shall be robust against unexpected touch object reports.

2.1.9.3.2 IFS-MMI2C-SR-REQ-140558/B-Touch Screen Calibration (Atmel T-Series)

The display supplier shall calibrate:

- T100 instance 0 enabled
- T27 pinch, stretch enabled

The LVDS Source Module shall utilize these touch objects for single-touch and multi-touch detection.

The display supplier may utilize any other features to provide robust touch-detection. The LVDS Source module shall be robust against unexpected touch object reports.

2.1.9.3.3 IFS-MMI2C-SR-REQ-202034/A-Signal Limit Threshold

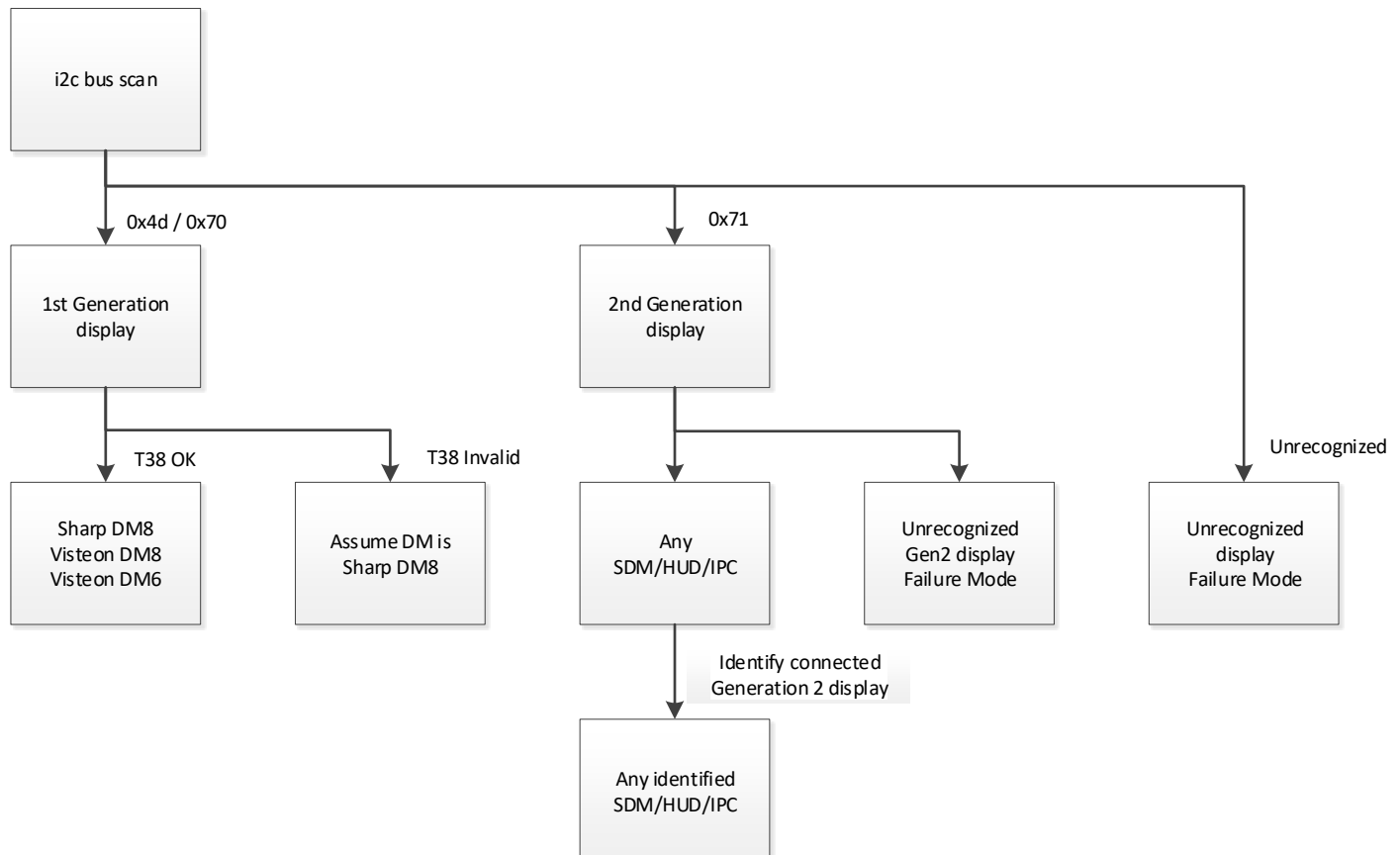
The display supplier shall define thresholds for the T25 signal limit test.

2.1.9.4 Cypress Touch Controllers

2.1.10 Initialization and Autodetect

2.1.10.1 IFS-MMI2C-SR-REQ-140547/C-Identifying Connected Display

At each power-up, I²C Master shall dynamically identify what kind of display is connected with the following strategy:



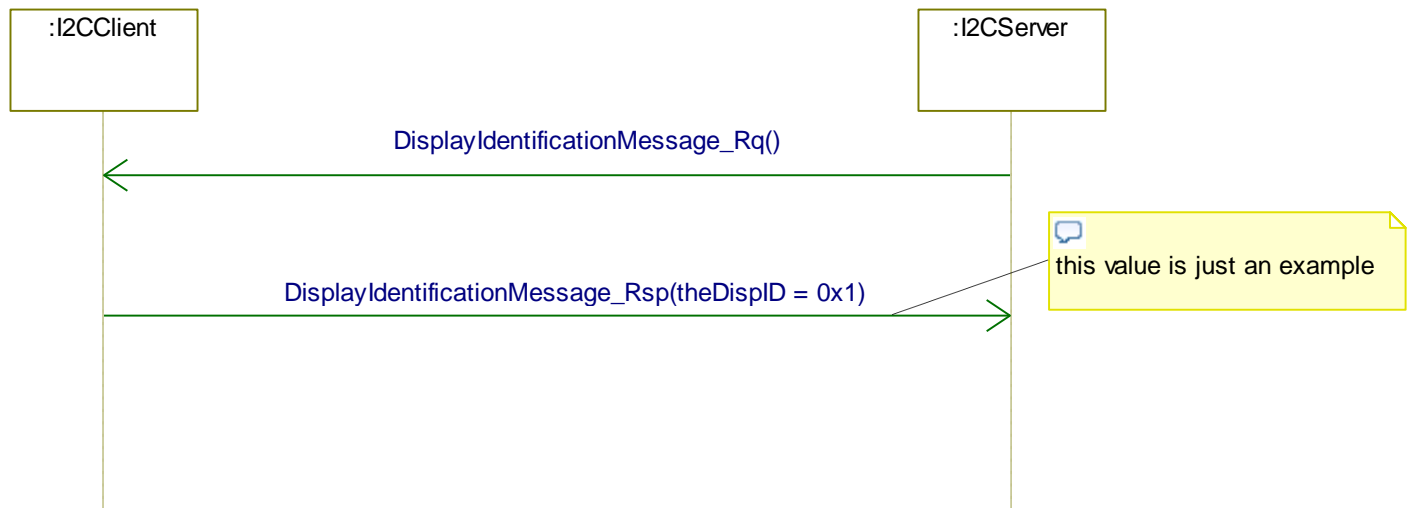


The I²C Master must detect I²C bus errors and restart the sequence until a decision is made.
The I²C Master may support (S)DM/HUD/IPC hotplug. In this case, the I²C Master shall re-run the display identification sequence each time the LVDS cable is disconnected / connected. All dependent steps must be re-evaluated: which device driver to use, which calibration file to load (if applicable) and which HMI to display.

2.1.10.2 IFS-MMI2C-SR-REQ-140548/A-Identifying Connected Generation 2 Display

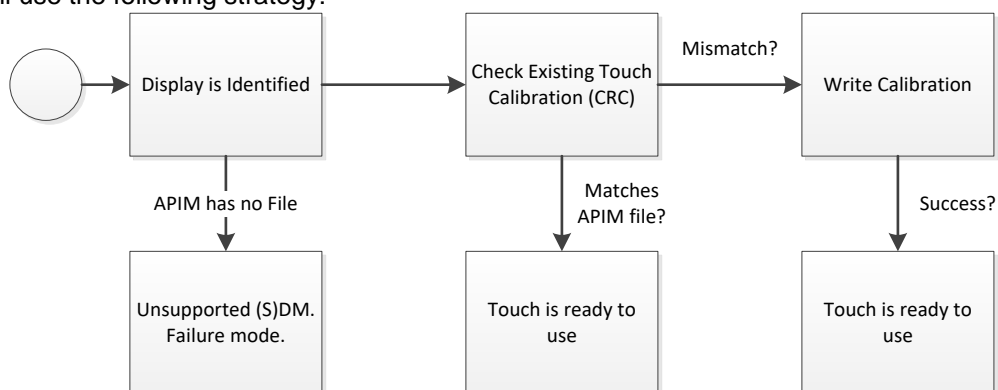
If the LVDS Source Module has been identified that a 2nd generation display is connected it has the possibility to request display ID for choosing e.g. correct calibration.

See requirement “Display Identification Table” for further information on display ID.



2.1.10.3 IFS-MMI2C-SR-REQ-140550/A-Touch Calibration

If applicable, the LVDS Source Module is responsible to write the correct touch calibration into the display module. LVDS Source Module shall use the following strategy:



LVDS Source Module shall examine the display, inspect the calibration written into the display, determine if a different calibration is available, and write the calibration if needed.

LVDS Source Module must use a technique that checks the entire touch calibration; computing a hash (CRC) is acceptable, but reading a version number or identifying-mark on the calibration is not acceptable.

LVDS Source Module must minimize flash-memory wear by rewriting the calibration only when required by the strategy.

**2.1.11 IFS-MMI2C-SR-REQ-140554/C-Timer Settings**

The timers described in this section shall have the following values:

Timer	Value
tDISP_EN(*1)	200ms
tDISP_DIS(*1)	200ms
tSHTDWN	500ms
tLVDSslave_RESET	1000ms

(*1) only valid in case of a display

- tDISP_EN(*1): Maximum time to enable LCD Panel, LCD Backlight, and display an image on the LCD.
- tDISP_DIS(*1): Maximum time to disable LCD Panel, LCD Backlight, and show a blank screen.
- tSHTDWN: Maximum time to perform a controlled shutdown.

2.1.12 IFS-MMI2C-SR-REQ-199145/B-Time to Ready

All I²C Slaves (e.g. TouchScreenController and display microcontroller) shall be capable of communicating on the I²C bus 300ms after the filtered battery supply is enabled. Actual communication cannot begin until LOCK is achieved on the LVDS link between the LVDS Client and LVDS Source Module.

2.1.13 Diagnostics

This table summarizes the diagnostic requirements:

Requirement	Gen1	Gen2	DID	Byte	Bit	DTC	Name
REQ-199349	X		\$FD1A	2	4	B108E-01	
REQ-199350		X	\$FD1A	2	1	B108E-4A	
REQ-197882		X	\$FD1A	2	5	B108E-02	Unexpected Reset
REQ-197881	X	X	\$FD1A	1	3	B108E-02	Reset Request
REQ-197883	X	X	\$FD0A	1	7	B108E-01	
REQ-197885	X	X	\$FD0A	1	5	B108E-4B	
REQ-197884	X	X	\$FD1A	2	7	B108E-01	
REQ-197886	X	X	\$FD0A	1	6	B108E-01	
REQ-199144	X		\$FD1A	2	3	B108E-01	
REQ-199371	X	X	\$FD1A	2	0	U0162-00	LVDS Link Fault
REQ-197887		X	\$FD1A	2	6	B108E-02	Loss of Lock
REQ-199353	X	X	\$FD1A	1	4	B108E-87	
REQ-199355	X	X	\$FD1A	1	1	B108E-87	
REQ-199354	X	X	\$FD1A	1	6	B108E-01	
REQ-199369	X	X	\$FD1A	1	5	B108E-01	
REQ-199370	X	X	\$FD1A	1	0	B108E-01	
REQ-266614		X	\$FD1A	1	6	B108E-01	
REQ-266615		X	\$FD1A	1	5	B108E-01	
REQ-266616		X	\$FD1A	1	0	B108E-01	

2.1.13.1 IFS-MMI2C-SR-REQ-199349/A-Invalid Atmel User Data (Gen1)

Applicable: Gen1

During initialization of a Gen1 display module, the LVDS Source Module reads the electronic identifier programmed into Atmel T38 user data.

If the 8 byte electronic identifier does not match any value defined in REQ-140577, the LVDS Source Module shall set DID \$FD1A byte 2 bit 4: Mismatched Electronics Identifier.

The LVDS Source Module shall set DTC B108E-01 based on this error. The display will operate by assuming the display is a Visteon DM8, but touch may perform poorly if the display module was designed for a different calibration.



2.1.13.2 IFS-MMI2C-SR-REQ-199350/A-Unsupported Display (Gen2)

Applicable: Gen2

During initialization of a Gen2 display module, the LVDS Source Module reads the electronic identifier from display microcontroller subaddress 0x01.

If the LVDS Source Module does not support the type of display which is connected, it shall set DID \$FD1A byte 2 bit 1: Unsupported Display.

The LVDS Source Module shall set DTC B108E-4A based on this error.

2.1.13.3 IFS-MMI2C-SR-REQ-197882/B-Unexpected Reset

Applicable: Gen2

The I²C Slave module bit INIT is cleared (=0) at power-on, and set (=1) at I²C Slave enable. Any transition from 1 -> 0 during normal operation indicates that I²C Master Module was operating normally but:

1. The I²C Slave was disconnected and same-or-different I²C Slave was connected.
2. Or the I²C Slave reset, for example: low-voltage, watchdog, etc.

After a Gen2 I²C Slave is initialized, I²C Master Module shall monitor INIT and set DID Unexpected Reset if an unexpected reset was detected.

The I²C Master Module shall implement a counter and set DTC Unexpected Reset if there are greater than 5 events detected during any single ignition cycle.

2.1.13.4 IFS-MMI2C-SR-REQ-197881/B-Reset Request

Applicable: Gen1, Gen2

The I²C Slave module is permitted to set RST_RQ to request a full power-cycle. Gen1 I²C Slave s are known to make this request after detecting loss-of-lock, low-voltage dropout, and backlight fault. The I²C Slave shall only make this request if the fault can be fixed by cycling power.

The I²C Master Module shall monitor bit RST_RQ and set DID Reset Request: I²C Slave Micro Reset if a reset was requested.

The I²C Master Module shall implement a counter and set DTC Reset Request if there are greater than 5 reset requests during any single ignition cycle.

2.1.13.5 IFS-MMI2C-SR-REQ-197883/A-LCD Connection

Applicable: Gen1, Gen2

The display module shall monitor the flexible cable connecting PCB to LCD panel, and report the status with bit DCERR.

The LVDS Source Module shall monitor bit DCERR and set DID \$FD0A bit 7: Display Connection Error.

The LVDS Source Module shall set DTC B108E-01 based on this error. The diagnostic has detected a faulty connection inside the display, and the recommended action is to replace the display.

2.1.13.6 IFS-MMI2C-SR-REQ-197885/A-Temperature Derating

Applicable: Gen1, Gen2

The display module shall monitor temperature, and report any over-temperature condition with bit TERR.

The LVDS Source Module shall monitor bit TERR and set DID \$FD0A bit 5: Thermistor Backlight De-rating.

The LVDS Source Module shall set DTC B108E-4B based on this error.



2.1.13.7 IFS-MMI2C-SR-REQ-197884/A-LCD Backlight

Applicable: Gen1, Gen2

The display module shall monitor the LCD backlight controller for any fault, and report the status with bit BLERR.

The LVDS Source Module shall monitor bit BLERR and set DID \$FD1A byte 2 bit 7: Backlight Circuit Fault.

The LVDS Source Module shall set DTC B108E-01 based on this error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.8 IFS-MMI2C-SR-REQ-197886/A-LCD Module / Panel

Applicable: Gen1, Gen2

If the display module is capable of monitoring the LCD panel for a fault, it shall report the status with bit LCDERR. Not all display modules are capable of this diagnostic.

The LVDS Source Module shall monitor bit LCDERR and set DID \$FD0A byte 1 bit 6: Touch Screen Error.

The LVDS Source Module shall set DTC B108E-01 based on this error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.9 IFS-MMI2C-SR-REQ-199144/A-Failure to Enable (Gen1)

Applicable: Gen1

If the display module fails to report PON=1 after 5 attempts writing DISP_EN=1, the LVDS Source module shall set DID \$FD1A byte 2 bit 3: Failure to Enable.

The LVDS Source Module shall set DTC B108E-01 based on this error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.10 IFS-MMI2C-SR-REQ-199371/C-LVDS Link Detect Fault

Applicable: Gen1, Gen2

When the LVDS Source Module is providing power to the LVDS Slave Module, it shall monitor LVDS chip register "LINK Status". If the LVDS Source Module detects an LVDS serial link fault it shall set DID "LVDS Link Fault"

The LVDS Source Module shall set DTC "LVDS Link Fault" based on this error. The diagnostic has detected a connection fault.

2.1.13.11 IFS-MMI2C-SR-REQ-197887/B-Loss of Lock (Gen2)

Applicable: Gen2

While enabled (DISP_EN=1), the display module shall monitor the deserializer LOCK pin for any loss-of-lock and latch the condition with bit LLOSS.

The LVDS Source Module shall monitor bit LLOSS and set DID \$FD1A byte 2 bit 6: Loss of Lock Fault if the deserializer reports a loss-of-lock event.

The LVDS Source Module shall implement a counter and set DTC B108E-02 if there are greater than 5 loss-of-lock events during any single ignition cycle. The diagnostic has detected a signal-quality problem with communication to the display module.

2.1.13.12 IFS-MMI2C-SR-REQ-199353/A-Loss of Communication with Display Microcontroller

Applicable: Gen1, Gen2

During normal operation, the LVDS Source Module display driver shall determine loss-of-communication by monitoring for persistent I²C NAK response.



If the LVDS Source Module detects a condition where the LVDS link is operational but the display microcontroller has a persistent NAK response (> 500ms), it shall set DID \$FD1A byte 1 bit 4: Lost Communication with Display Microprocessor.

The LVDS Source Module shall set DTC B108E-87 for this error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.13 IFS-MMI2C-SR-REQ-199355/A-Loss of Communication with Touch IC

Applicable: Gen1, Gen2

During normal operation, the LVDS Source Module display driver shall monitor for persistent I²C communication faults.

If the LVDS Source Module detects a condition where the LVDS link is operational but the touch IC has a persistent NAK response, it shall set DID \$FD1A byte 1 bit 1: Lost Communication with Touch Controller.

The LVDS Source Module shall set DTC B108E-87 for this error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.14 IFS-MMI2C-SR-REQ-199354/B-AVdd Power Test (Atmel-only)

Applicable: Gen1, Gen2

During Self-Test [0202] the LVDS Source Module shall command the Atmel Touch IC to run T25 AVdd Power Test. Based on the test result, the LVDS Source Module shall set DID \$FD1A byte 1 bit 6: Touch Circuit Fault.

The LVDS Source Module shall set DTC B108E-01 for any error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.15 IFS-MMI2C-SR-REQ-266614/A-AVdd Power Test (Cypress-only)

Applicable: Gen2

The LVDS Source Module shall monitor the Cypress touch IC error register. Based on the AVDD error result, the LVDS Source Module shall set DID \$FD1A byte 1 bit 6: Touch Circuit Fault.

The LVDS Source Module shall set DTC B108E-01 for any error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.16 IFS-MMI2C-SR-REQ-199369/B-Pin Fault Test (Atmel-only)

Applicable: Gen1, Gen2

During Self-Test [0202] the LVDS Source Module shall command the Atmel Touch IC to run T25 Pin Fault Test. Based on the test result, the LVDS Source Module shall set DID \$FD1A byte 1 bit 5: Touch Panel Fault.

The LVDS Source Module shall set DTC B108E-01 for any error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.17 IFS-MMI2C-SR-REQ-266615/A-Pin Fault Test (Cypress-only)

Applicable: Gen2

During Self-Test [BIST] the LVDS Source Module shall command the Cypress Touch IC to run Built In Self Test. Based on the test result for SHORTS, the LVDS Source Module shall set DID \$FD1A byte 1 bit 5: Touch Panel Fault.

The LVDS Source Module shall set DTC B108E-01 for any error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.18 IFS-MMI2C-SR-REQ-199370/B-Signal Limit Test (Atmel-only)

Applicable: Gen1, Gen2



During Self-Test [0202] the LVDS Source Module shall configure appropriate signal levels then command the Atmel Touch IC to run T25 Signal Limit Test. Based on the test result, the LVDS Source Module shall set DID \$FD1A byte 1 bit 0: Touch Panel Range/Performance.

The LVDS Source Module shall set DTC B108E-01 for any error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.13.19 IFS-MMI2C-SR-REQ-266616/A-Signal Limit Test (Cypress-only)

Applicable: Gen2

During Self-Test [BIST] the LVDS Source Module shall command the Cypress Touch IC to run Built In Self Test. Based on the test result for Cp/Cm Tests, the LVDS Source Module shall set DID \$FD1A byte 1 bit 0: Touch Panel Range/Performance.

The LVDS Source Module shall set DTC B108E-01 for any error. The diagnostic has detected a failure inside the display, and the recommended action is to replace the display.

2.1.14 Failure Mode Avoidance

2.1.14.1 IFS-MMI2C-SR-REQ-202030/B-Reset Request

The LVDS Slave module is permitted to set RST_RQ to request a full power-cycle. The LVDS Slave shall only make this request if the fault can be fixed by cycling power (e.g. Gen1 displays are known to make this request after detecting loss-of-lock, low-voltage dropout, and backlight fault).

The LVDS Source Module shall monitor bit RST_RQ. If bit RST_RQ=1, the LVDS Source Module shall perform a controlled power shutdown. After $t_{LVDS\text{Slave_RESET}}$ expires the LVDS Source Module shall re-enable power to the LVDS Slave and perform a normal re-initialization sequence.

2.1.14.2 IFS-MMI2C-SR-REQ-202033/B-Loss of Communication

During normal operation, if the LVDS Source Module detects a condition where the LVDS Slave has become non-functional, either Link Detect Fault or Loss of Communication, it shall perform a full power-cycle as an attempt to recover the LVDS Slave.

The full power-cycle sequence is: disable power, wait $t_{LVDS\text{Slave_RESET}}$, then perform a full re-initialization sequence.

2.1.14.3 IFS-MMI2C-SR-REQ-197874/A-Interrupt Polling

The LVDS chipset does not mirror interrupt status; it only asserts INTB on a falling-edge of INTB_IN. Because the system is edge-sensitive, it is possible for the system to enter an error-state where INTB_IN is asserted but INTB is deasserted.

The LVDS Source Module shall use a timer and run the normal interrupt handling if an interrupt has not been seen for 100ms. This is intended to recover the system from a "stuck interrupt" condition.

2.1.14.4 IFS-MMI2C-SR-REQ-199134/B-Restart AEQ Algorithm

The LVDS chipset has an undocumented auto equalization (AEQ) behavior. When attempting to establish an LVDS link, the deserializer will begin with the minimum EQ setting and try to lock. If unsuccessful, it increments EQ and tries again. It repeats this routine until lock is established. Resetting the deserializer forces a restart at the beginning of the algorithm.

In any situation where deserializer is powered and running the search algorithm before the serializer is ready, the EQ setting could lock to a larger-than-necessary value.

Therefore, the LVDS Source Module shall reset the deserializer:

- After resetting the serializer
- After changing LFMODE



2.1.14.5 IFS-MMI2C-SR-REQ-199143/A-Display Re-Enable (Gen1)

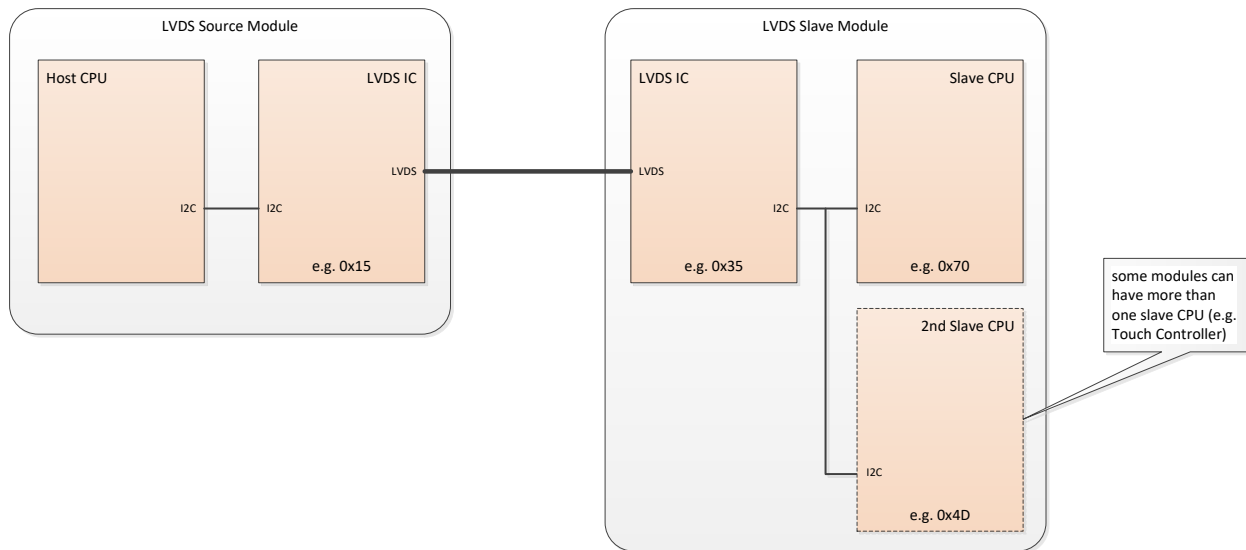
Note: This requirement is only applicable when LVDS Source Module is interfacing with a Generation 1 Display Module

If the LVDS Source Module enables the display (DISP_EN =1) and detects that the display has not actually enabled (PON =0), it shall re-try to enable the display a maximum of 5 times.

2.1.14.6 IFS-MMI2C-SR-REQ-199348/B-Atomic Transaction

The LVDS chipset as an undocumented requirement regarding the sequence of I²C messages across the LVDS link. Any transaction to the SER or DES must be performed in an “atomic” manner, because any I²C message that flows across the link will overwrite the register offset.

For example:



The following sequences are permissible:

- Write offset to 0x15, read 0x15, write offset to 0x4D, read 0x4D
- Write offset to 0x4D, write offset to 0x70, read 0x4D, read 0x70

The following sequences are not permissible and result in **incorrect transactions**:

- Write offset to 0x15, write offset to 0x4D, **read 0x15**, read 0x4D
- Write offset to 0x35, write offset to 0x4D, **read 0x35**, read 0x4D

Note: All addresses mentioned in this requirement are just examples to be more descriptive.

2.1.14.7 IFS-MMI2C-SR-REQ-199357/A-Avoid driving INTB_IN during loss-of-lock

The LVDS chipset has an undocumented requirement regarding a falling-edge of INTB_IN during loss-of-lock. In this situation the interrupt may be missed, and the LVDS Source Module will not receive the signal.

The display module may use a “buffer-and-defer” strategy (STR-307941) to delay generating an interrupt request until lock is regained.

The system will recover when another interrupt arrives, or worst-case when LVDS Source Module performs interrupt polling (REQ-197874).

2.1.14.8 IFS-MMI2C-SR-REQ-226922/A-Write Configuration to Flash

[Several versions of Atmel's Touch IC have an undocumented requirement to maintain power when saving a configuration to non-volatile memory with the BACKUPNV command.](#)



If the LVDS Source Module removes power during a BACKUPNV operation, the configuration region of the flash memory may become unstable. The Atmel Touch IC will detect the condition, will not enter the firmware, and will remain stuck in the bootloader until actions are taken to clear the configuration region.

Because the LVDS Source Module cannot guarantee an uninterrupted BACKUPNV operation, the LVDS Source Module shall support in-field recovery using Atmel's recommended technique.

2.1.14.9 IFS-MMI2C-SR-REQ-261350/A-Atmel Touch IC Maximum Resets



2.2 IFS-MMI2C-FUN-REQ-140573/B-Generation 1 Display Modules

2.2.1 IFS-MMI2C-SR-REQ-140577/B-Display Identifier - Legacy

Display supplier must write a set of bytes into the Atmel T38 user data, which will serve as an electronic identifier. The only acceptable values are:

Display	Atmel T38 (user data) bytes
Sharp DM8	01 44 50 03 20 01 E0 30
Sharp DM8	01 45 50 03 20 01 E0 07
Visteon DM8	01 24 50 03 20 01 E0 F3
Visteon DM6	01 24 41 03 20 01 E0 42

LVDS Source module must never modify, overwrite, or erase the T38 user data object.

LVDS Source module shall read the T38 user data object to identify the type of the display it is connected to, and use the correct configuration file for the attached DM.

2.2.2 IFS-MMI2C-SR-REQ-140586/A-Touch Screen Controller Operation - Legacy

The display module supports a touch interface on some versions. The touch screen controller shall use the standard I²C communication protocol defined by the touch screen controller vendor. The interrupt lines shall be serviced as defined by both the touchscreen controller documentation and the TI FPD Link III documentation for handling the back-channel interrupt signal.

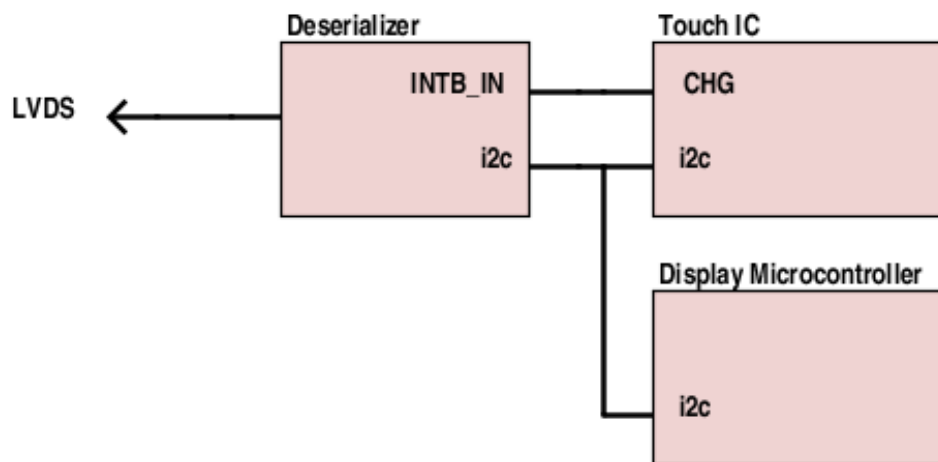
2.2.3 IFS-MMI2C-SR-REQ-140574/B-LVDS Source Module Display Status Message Polling - Legacy

The LVDS Source module is expected to read of the Status Message on every initialization, power state change, and at a frequency of 1 Hz while the display is powered. The LVDS Source module shall cease polling within 1s after issuing the Display Shutdown Message.

The LVDS Source module shall use the polling of the Status Message to verify the DM state (REQ-199143) and active communication (REQ-199353).

2.2.4 IFS-MMI2C-SR-REQ-197942/A-Interrupt

In this design, only the touch IC drives deserializer INTB_IN. All displays have touch, so the schematic should look like:



When a touch event occurs, the touch IC asserts the hardware interrupt line. Deserializer pin INTB_IN is edge-sensitive; the falling-edge will signal the LVDS Source Module with an interrupt.



When the LVDS Source Module receives the interrupt it shall:

1. Read SER subaddress 0xC7 (ISR).

Note: This action clears serializer INTB, preparing the system to receive a new interrupt on the next falling-edge of deserializer INTB_IN.

2. Service the touch IC.

2.2.5 IFS-MMI2C-SR-REQ-197934/A-Loss of Lock

The display shall monitor deserializer LOCK pin. For any loss-of-lock >35 ms, the display shall:

- Automatically disable the display (PON =0) to prevent showing bad video. This will turn off the LCD backlight and panel.
- Request reset (RST_RQ = 1).

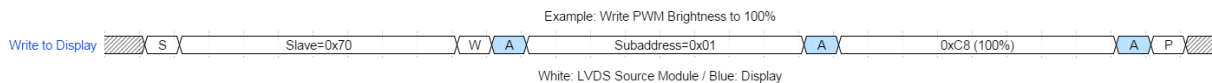
The display shall maintain functionality of the TSC and display microcontroller to communicate on I²C in case communication is re-established. If lock is re-established and the LVDS Source Module reads this status (RST_RQ =1) it shall perform the actions described in REQ-202030.

If lock is not re-established and LVDS Source Module detects a complete loss of communication it shall perform the actions described in REQ-202033.

2.2.6 I2C Bus Interface

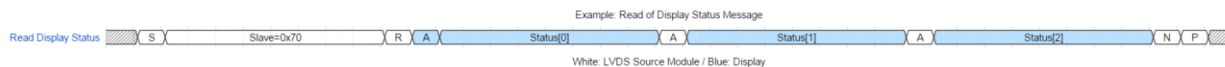
2.2.6.1 IFS-MMI2C-SR-REQ-197944/A-Write to Display Microcontroller

This diagram shows a typical write by the LVDS source module. Writes are implemented by writing the subaddress then exactly-one byte of data:



2.2.6.2 IFS-MMI2C-SR-REQ-197943/A-Read from Display Microcontroller

This diagram shows a typical read by the LVDS Source Module. The display always responds with the Display Status Message:



Note: Because this protocol does not utilize a subaddress to change the read message, it is not possible to read-back a written value. For example, PWM brightness is a write-only value and cannot be read-back.

2.2.6.3 IFS-MMI2C-SR-REQ-197946/A-Read from Display Microcontroller Beyond Defined Length

The original publication of this document did not contain any requirement for the bytes beyond the defined length of the Display Status (read) message. This, and future, publications cannot rely on any specific contents of these bytes.

DM8 is known to report vendor-specific information beyond the first three bytes.

LVDS Source Module shall not attempt to read more than 3 bytes from the Display Status message.



2.2.7 I2C Messages - Master reads from Slave

2.2.7.1 IFS-MMI2C-SR-REQ-140589/B-Display Status Message - Legacy

The Display Status message provides a mechanism to transmit general display related status back to the LVDS Source Module:

Access: Read-Only

Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	-	-	-	TSC_RDY	PON	DCERR	TERR	LCDERR
[1]	TCH_TYPE		DISP_SIZE			DISP_RES		
[2]	-	-	-	-	-	-	-	RST_REQ

- TSC_RDY: Touchscreen Ready
0 Touch Screen Controller is not ready (held in reset).
1 Touch Screen Controller is ready for use.
- PON: Power On
This signal reports the current status of display enable.
This bit is set after commanding display enable (DISP_EN = 1).
This bit is cleared after any event which causes the display to automatically self-disable (DISP_EN = 0) including: loss-of-lock, backlight fault, etc.
- DCERR: Disconnect error
This bit indicates that display microcontroller detects an open-circuit to LCD panel.
0 No error
1 Open-circuit exists
- TERR: Temperature Derating
This bit indicates that display microcontroller is operating in temperature derating mode.
0 Operating normally
1 Operating in temperature derating mode
- LCDERR: LCD Error
This bit is set when the display microcontroller detects an LCD-related fault.
0 Operating normally
1 Fault detected
- TCH_TYPE: Touch Type
Indicates the type of touch controller.
0x00 Atmel maXTouch
Earlier publications defined other values for future expansion. Only this value has been implemented in a production display.
- DISP_SIZE: Display Size
Indicates the LCD panel viewable size.
0x01 6.5"
0x02 8"
Earlier publications defined other values for future expansion. Only these values have been implemented in a production display.
- DISP_RES: Display Resolution
Indicates the LCD resolution.
0x01 800x480
Earlier publications defined other values for future expansion. Only this value has been implemented in a production display.
- RST_REQ: Request Request
This bit is set when the display requires a full power-cycle reset to resolve some problem. See REQ-197934 for requirements around loss-of-lock.



- 0 Operating normally
- 1 Display requests a reset (full power-cycle)

The LVDS Source Module shall execute a read of the Display Status Message on every initialization and power state change, as needed to determine current display status. **Note:** Some displays contain a bug and will not enable unless this message has been read.

2.2.8 I2C Messages - Master writes to Slave

0x01	W	LCD Backlight PWM Value
0x02	W	Display Scanning
0x03	W	Display Enable
0x04	W	Display Shutdown
0x80-0x89	W	Reserved for Supplier
0xF0-0xFF	W	Reserved for Supplier

2.2.8.1 IFS-MMI2C-SR-REQ-140595/B-0x01 LCD Backlight PWM Value

The LCD Backlight PWM message contains the brightness information for a PWM output that operates in half-percent increments.

Subaddress: 0x01

Access: Write-Only

Default Value: 0x04 (=2%)



- BL_PWM: LCD Backlight PWM
Value in half-percent between 0% (0x00) and 100% (0xC8).
If out-of-range (0xC9-0xFF) the PWM shall be set to 100%.

The LVDS Source Module shall not send an out of range value in the LCD Backlight PWM message.

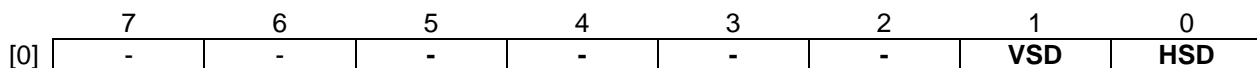
2.2.8.2 IFS-MMI2C-SR-REQ-140596/B-0x02 Display Scanning

The Display Scanning message provides a mechanism to control the LCD scanning direction.

Subaddress: 0x02

Access: Write-Only

Default Value: 0x00





- VSD: Vertical Scanning Direction.
 - 0 Top to Bottom
 - 1 Bottom to Top (engineering test-use only)
- HSD: Horizontal Scanning Direction
 - 0 Left to Right
 - 1 Right to Left (engineering test-use only)

Display shall adjust the VRV / HRV pins on the LCD panel according to the value in this subaddress.

Display supplier shall ensure that video is oriented correctly, with default value 0x00, when the display is installed in the vehicle. LVDS Source Module is not responsible to set this subaddress based on the orientation of the LCD Panel. The capability is provided only for engineering test.

2.2.8.3 IFS-MMI2C-SR-REQ-140597/B-0x03 Display Enable

The Display Enable message provides a mechanism for the LVDS Source Module to tell the DM to enable the LVDS display output.

Subaddress: 0x03
Access: Write-Only
Default Value: 0x00

	7	6	5	4	3	2	1	0
[0]	-	-	-	-	-	-	-	DISP_EN

- DISP_EN: Display Enable.
 - Note: This controls both the LCD Panel and the LCD Backlight.
 - 0 Command display disabled
 - 1 Command display enabled

This subaddress sets the commanded status. The actual status (PON) may be different, due to delay or an error condition.

The LVDS Source module shall not attempt to enable unless it is driving a valid pixel clock and video signal.

If the Enable Display Output bit is set to enabled during a controlled shutdown the DM shall ignore this bit and complete the shutdown.

2.2.8.4 IFS-MMI2C-SR-REQ-140600/B-0x04 Display Shutdown

The Display Shutdown message provides a mechanism for the LVDS Source Module to tell the DM that it will remove power from the DM and it should perform a controlled shutdown.

Subaddress: 0x04
Access: Write-Only
Default Value: 0x00

	7	6	5	4	3	2	1	0
[0]	-	-	-	-	-	-	-	SHDWN

- SHDWN: Display Shutdown
 - 0 Normal operation.
 - 1 Command display module to perform controlled shutdown.

After sending a controlled shutdown request, the LVDS Source module shall not remove power or stop driving video signal (including pixel clock) before t_{SHDWN} expires. After the timer expires the LVDS Source Module shall remove power.



During an uncontrolled shutdown (i.e. battery removal, etc.) t_{SHUTDOWN} does not apply.

To enable function again, the LVDS Source Module must perform the normal power initialization sequence.

2.2.8.5 IFS-MMI2C-SR-REQ-140603/B-I2C Reserved Messages - Legacy

The write messages at subaddress 0x80-0x89 and 0xF0-0xFF shall be reserved for internal supplier uses.



2.3 IFS-MMI2C-FUN-REQ-140607/C-Generation 2 Display Modules

2.3.1 IFS-MMI2C-SR-REQ-140609/A-Display Module Identification

The display module supplier shall program into the display microcontroller, at time of manufacturing, e.g. following information:

- Display ID
- Ford Part Number
- Electronic Serial Number
- Software Part Number (Firmware Version)

2.3.2 IFS-MMI2C-SR-REQ-140612/B-Touch Screen Controller Operation

The display module supports a touch interface on some versions. The touch screen controller shall use the standard I²C communication protocol defined by the touch screen controller vendor. The interrupt lines shall be serviced as defined by both the touchscreen controller documentation and the TI FPD Link III documentation for handling the back-channel interrupt signal.

2.3.3 IFS-MMI2C-SR-REQ-140613/B-Button Controller Operation

The display module supports a button array interface on some versions. The Display Module shall trigger an interrupt whenever a button press with button debounce or a button release with hysteresis occurs. The button press information shall be transmitted via the standard I²C communication protocol defined in this document.

2.3.4 Interrupt

In this design, multiple functions within the display are able to interrupt the LVDS Source Module. These include:

1. Any display status change / error event
2. CHG asserted by the Touch IC (for displays with touch)
3. Any button message (for displays with buttons)
4. Any rotary message (for displays with one or more rotary)

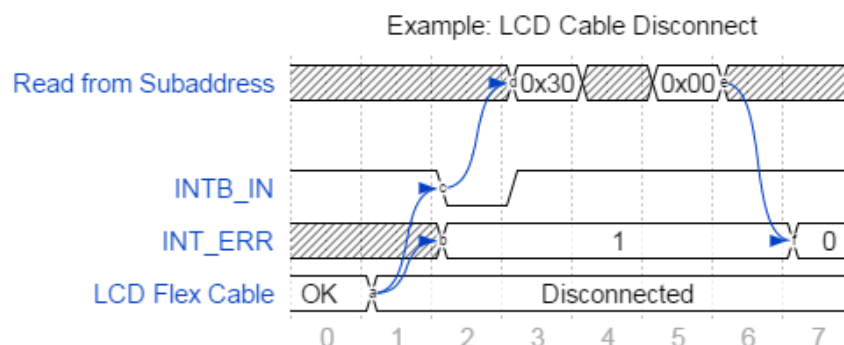
The display supplier may choose any hardware implementation that honors the interface requirements.

2.3.4.1 IFS-MMI2C-SR-REQ-197941/B-Interrupt Request

The LVDS chipset does not mirror interrupt status; it only asserts INTB on a falling-edge of INTB_IN. In this system, the interrupt request is an edge-triggered event.

The I²C Slave shall generate an interrupt request whenever an interrupt-generating event occurs. An interrupt-generating event is defined as any event that could cause a bit in subaddress 0x30 (ISR) to transition from 0 -> 1.

This diagram shows an example with the relationship of reading and clearing:



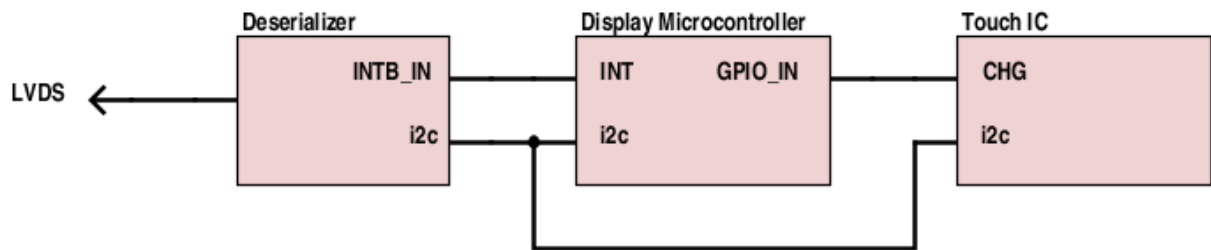


- Over temperature is an interrupt-generating event. The I²C Slave microcontroller sets corresponding bit in subaddress 0x30 (e.g. TERR, OVRTMP) here named as INT_ERR, then generates an interrupt request by driving INTB_IN (t=2).
Note: The I²C Slave will generate an interrupt request for this event; it doesn't matter if INT_ERR =1 already from a previous unserved interrupt.
- Read of I²C Slave microcontroller subaddress 0x30 (t=3) to understand cause of interrupt.
- Read of I²C Slave microcontroller subaddress 0x00 (t=5) clears INT_ERR (t=7).
Note: The fault still exists.

2.3.4.2 Single IC driving INTB_IN

The display may implement a circuit where display microcontroller is the only IC that drives INTB_IN. This is recommended as the simplest implementation.

For displays with touch, the block-diagram would look like:

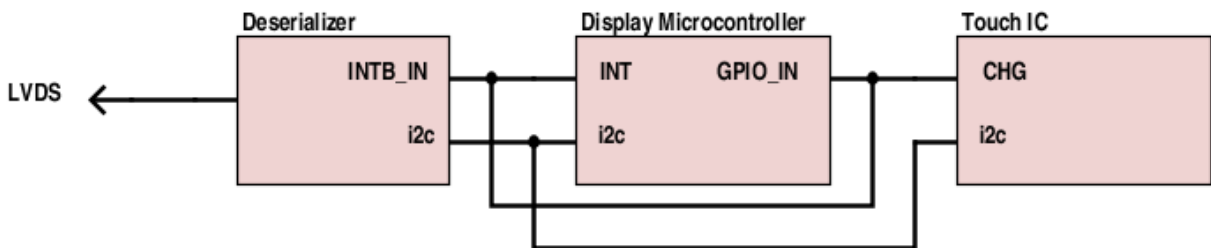


In this case, the display microcontroller monitors CHG and generates an interrupt request for any interrupt-generating event.

2.3.4.3 Multiple ICs driving INTB_IN

The display may implement a circuit where both display microcontroller and touch IC are able to drive the INTB_IN signal (as open-drain).

For displays with touch, the block-diagram would look like:



In this case, INTB_IN is driven by a different IC for each feature:

- Touch IC drives INTB_IN to generate an interrupt request for INT_TCH.
- Display microcontroller drives INTB_IN to generate an interrupt request for INT_BTN and INT_ERR.

Display microcontroller reads INTB_IN to determine when the Touch IC is requesting an interrupt, so it can report an accurate INT_TCH value.

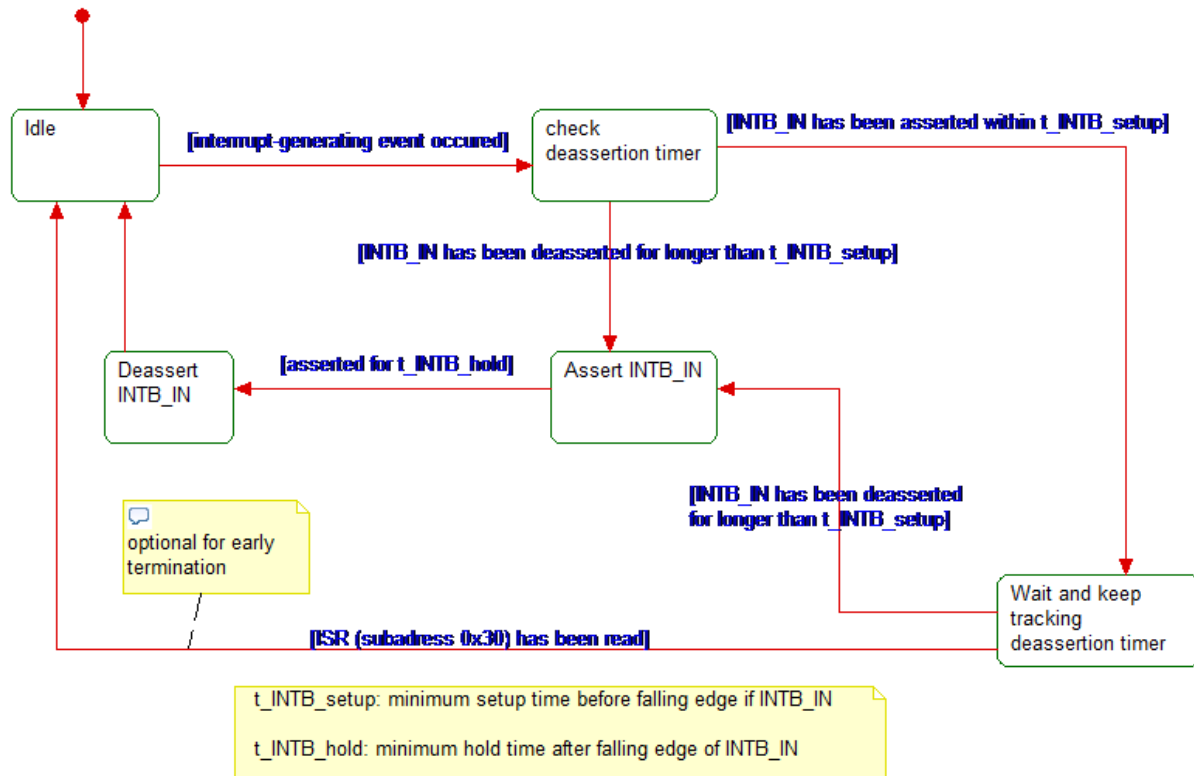
This circuit is vulnerable to a race-condition where two-or-more ICs attempt to generate an interrupt request at the same time. If multiple ICs drive INTB_IN an interrupt may be missed and the system may deadlock.



2.3.4.4 Interrupt Request Strategy

The display must implement a strategy to meet setup-time and hold-time requirements around an INTB_IN falling edge. This is applicable to both proposed hardware designs.

This diagram shows a strategy for the display microcontroller to “buffer-and-defer” the interrupt to meet timing constraints. The microcontroller monitors INTB_IN, verifies that INTB_IN is de-asserted for the required setup-time, drives INTB_IN for the required hold-time, then releases INTB_IN:



With two ICs driving INTB_IN (STR-307934), the display microcontroller may use this strategy to “buffer-and-defer” an interrupt request until after the touch IC releases INTB_IN.

2.3.4.5 IFS-MMI2C-SR-REQ-198936/B-Interrupt Service

When the LVDS Source Module receives the interrupt it shall:

1. Read SER subaddress 0xC7 (ISR).
Note: This action causes serializer to deassert INTB, preparing the system to assert INTB again on the next falling-edge of deserializer INTB_IN.
2. Read display microcontroller subaddress 0x30 (ISR). Determine which sources have an interrupt pending.
3. Service each pending interrupt: touch, buttons, rotary, or status.

2.3.5 IFS-MMI2C-SR-REQ-197933/B-Loss of Lock Displays

The display shall monitor deserializer LOCK pin. For any loss-of-lock, the display shall:

- Automatically turn-off LCD backlight and panel to prevent showing bad video. This will not affect the commanded setting (DISP_EN), but will be reported in the actual status (DISP_ST = 0).
- Latch that a loss-of-lock was detected (LLOSS = 1).
- If lock is regained, consider the commanded setting (DISP_EN) and determine if the LCD backlight and panel need to be automatically turned back on.

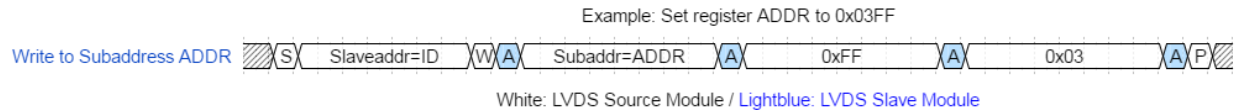


This strategy allows the system to recover quickly and automatically from a momentary loss-of-lock, without a full power-cycle. It also allows the LVDS Source Module to distinguish between signal-quality problems and a fault that requires full reset.

2.3.6 I2C Bus Interface

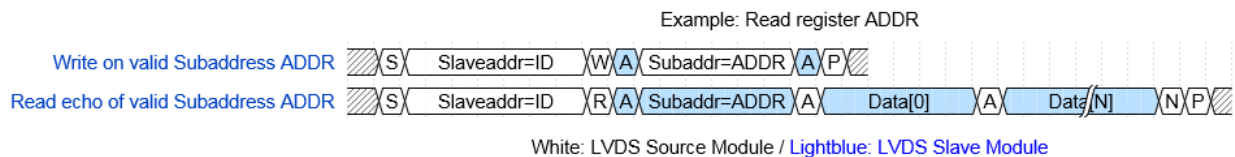
2.3.6.1 IFS-MMI2C-SR-REQ-140564/C-Write to Subaddress

This diagram shows a typical write by the I2C Master. Writes are implemented by writing the subaddress then one-or-more bytes of data:



2.3.6.2 IFS-MMI2C-SR-REQ-140561/C-Read from Subaddress

This diagram shows a typical read by the I2C Master. Reads are implemented by writing the subaddress, then reading an echo of the subaddress followed-by the data:

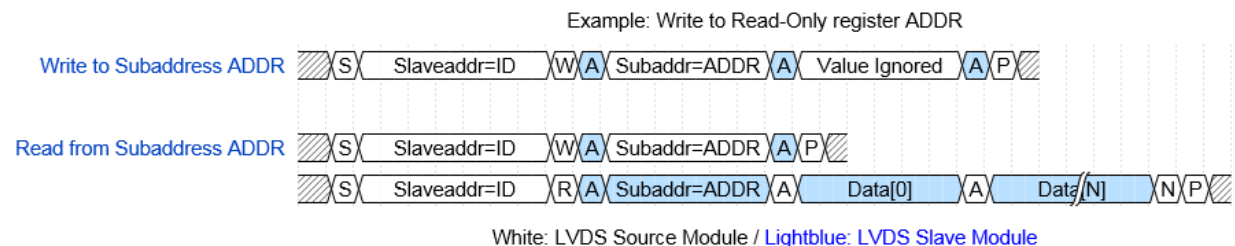


I2C Slave is not required to support I2C repeated-start bus cycle. The I2C Master shall not use an I2C repeated-start bus cycle to communicate with the I2C Slave microcontroller.

2.3.6.3 IFS-MMI2C-SR-REQ-197857/B-Write to Read-Only Subaddress

If I2C Master Module attempts to write to a read-only subaddress, the I2C Slave shall send ACK to indicate the bytes are received but make no state-change.

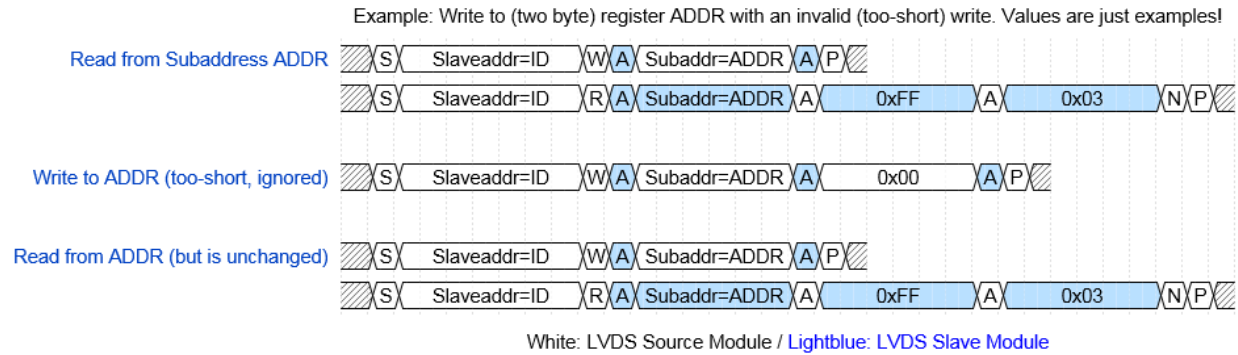
As an example with subaddress ADDR that will be read-only. This diagram shows that the I2C Slave ignores an attempt to write to the subaddress:



2.3.6.4 IFS-MMI2C-SR-REQ-140569/C-Write Underflow

If the I2C Master writes too-few bytes, the I2C Slave shall make no state-change.

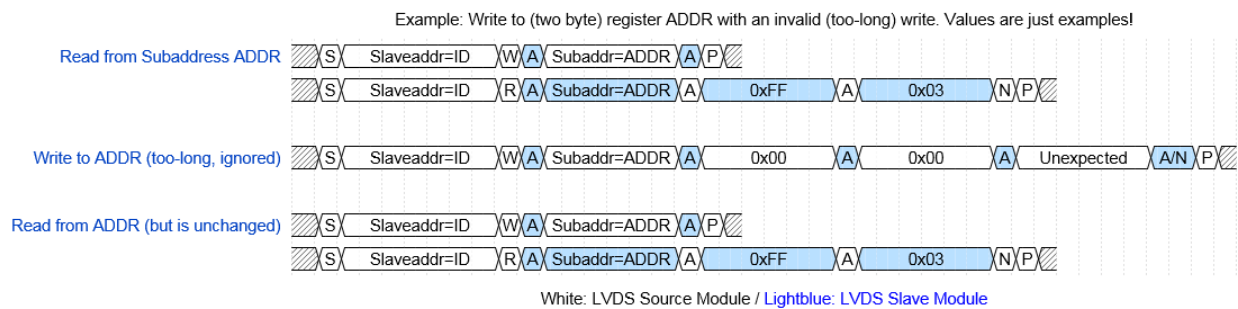
As an example with subaddress ADDR that will accept exactly two bytes of data. This diagram shows I2C Master attempting to write only one byte of data, and the I2C Slave making no state-change:



2.3.6.5 IFS-MMI2C-SR-REQ-140570/C-Write Overflow

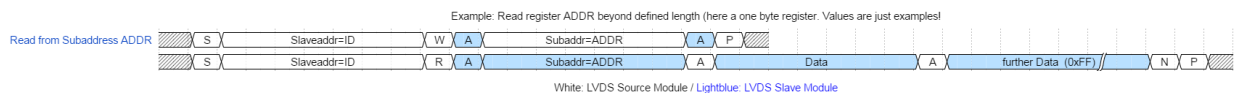
If the I²C Master attempts to write too-many bytes, the I²C Slave shall continue sending ACK to indicate the bytes are received, and make no state-change.

As an example with subaddress ADDR that will accept exactly two bytes of data. This diagram shows I²C Master attempting to write three bytes, and the I²C Slave making no state-change:



2.3.6.6 IFS-MMI2C-SR-REQ-197875/B-Read from Subaddress Beyond Defined Length

If I²C Master continues reading beyond the defined data-length of a subaddress, I²C Slave shall leave SDA undriven resulting in Data = 0xFF.



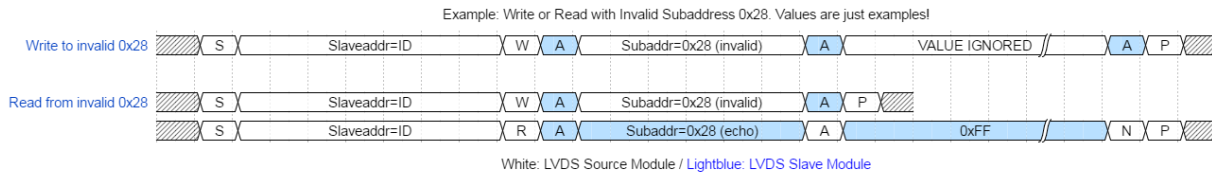
2.3.6.7 IFS-MMI2C-SR-REQ-140565/C-Undefined / Unsupported Subaddress

If the I²C Master attempts to write to an undefined subaddress, the I²C Slave shall:

- ACK to indicate the byte was received
- Update the internal subaddress register (for echo purposes)
- Take no other action because the request was unrecognized.

If I²C Master attempts to read from an undefined subaddress, the I²C Slave shall leave SDA undriven resulting in Data = 0xFF.

For example, subaddress 0x28 is undefined. This diagram shows the I²C Master attempting to write to, and read from, the undefined subaddress:



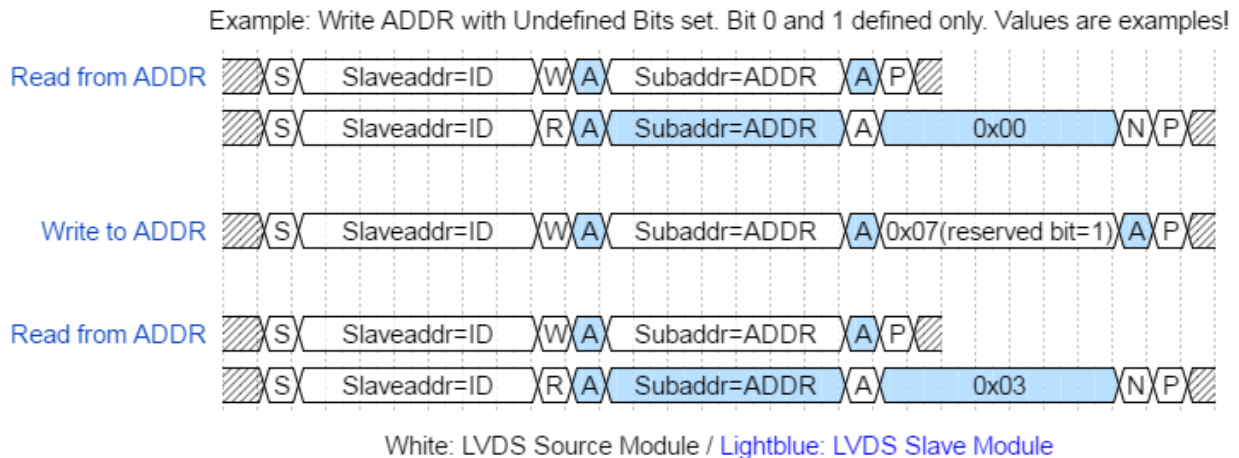
2.3.6.8 IFS-MMI2C-SR-REQ-140611/C-Reserved Bits

I²C Slave shall respond with “reserved” bits equal to zero.

2.3.6.9 IFS-MMI2C-SR-REQ-140566/C-Reserved Bits

If I²C Master writes to a subaddress and any reserved bit is set, the I²C Slave shall treat the reserved bit as “don’t care” and shall act upon the defined bits.

As an example with subaddress ADDR that has several undefined bits. This diagram shows the I²C Slave changing value from 0x00 to 0x03, and ignoring a reserved bit:



2.3.7 I2C Messages

0x00	R	Display Status
0x01	R	Display Identification
0x02	R/W	LCD Backlight PWM Value
0x03	R/W	Display Scanning
0x04	R/W	Display Enable
0x05	R/W	Display Shutdown
0x06	R/W	Button Backlight PWM Value
0x07	R	Button Status
0x08	R	Rotary Status



0x30	R	Interrupt Status Message (ISR)
0x31	R	Core Assembly
0x32	R	Delivery Assembly
0x33	R	Software Ford Part Number
0x34	R	Serial Number
0x35	R	Main Calibration Ford Part Number
0x40	R/W	Image Adjustment
0x41	R	Supplier Precalc Low Warping Table
0x42	R	Supplier Precalc Medium Warping Table
0x43	R	Supplier Precalc High Warping Table
0x44	R	Supplier EOL Low Warping Table
0x45	R	Supplier EOL Medium Warping Table
0x46	R	Supplier EOL High Warping Table
0x91	R/W	Light Ambient Sensor RAW Value
0x92	R/W	Forward Collision Warning Status
0xB0-0xFF	R/W	Reserved for Supplier

2.3.7.1 IFS-MMI2C-SR-REQ-140614/C-0x00 Display Status

The Display Status message provides a mechanism to transmit general display related status's back to the LVDS Source Module.

Subaddress: 0x00

Access: Read-Only

Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	TCERR	TSCERR	LLOSS	RST_RQ	DCERR	TERR	BLERR	LCDERR
[1]	-	-	-	-	-	INIT	TSC_ST	DISP_ST

- **TCERR:** Touch Connection Error (latched) (optional status)
This bit reports latched status of the flexible printed circuit connecting PCB to Touch Panel.
0 FPC is connected
1 FPC is disconnected
- **TSCERR:** Touch Screen Controller Error (latched) (optional status)
This bit reports latched status of touch panel controller
0 No Fault
1 Fault
- **LLOSS:** Loss of Lock (latched)
This bit reports latched status of loss-of-lock, as indicated by the deserializer LOCK pin.



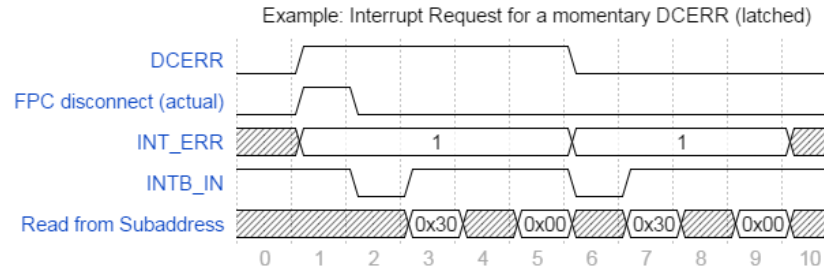
- 0 Lock is established
- 1 Lock is lost
- RST_RQ: Reset Request
This bit defaults clear, and is set when the display requires a full power-cycle reset to resolve some problem.
 - 0 Normal operation
 - 1 Request is requested
- DCERR: Disconnect error (latched)
This bit reports latched status of the flexible printed circuit connecting PCB to LCD Panel.
 - 0 FPC is connected
 - 1 FPC is disconnected
- TERR: Temperature Derating (latched)
This bit reports latched status of temperature derating mode.
 - 0 Inactive
 - 1 Active
- BLERR: LCD Backlight Error (latched)
This bit reports latched status of LCD backlight.
 - 0 No Fault
 - 1 Fault
- LCDERR: LCD Error (latched)
This bit reports latched status of LCD Panel.
 - 0 No Fault
 - 1 Fault
- INIT: Display Initialized
This bit defaults clear, and is set after the display has been enabled.
 - 0 Display has not been enabled during this power-cycle.
 - 1 Display has been enabled at least once during this power-cycle.

This bit is used by the host to detect an unexpected reset. Any transition from 1 -> 0 during normal operation indicates that the display may need a complete re-initialization.
- TSC_ST: Touch Controller Status
This bit reflects actual status. This may be different, due to delay or an error condition, from commanded value (TSC_EN).
 - 0 Touch Screen Controller is not ready (held in reset).
 - 1 Touch Screen Controller is ready for use.

If display has no touch screen controller, report 0.
- DISP_ST: Display Status
This bit reflects actual status. This may be different, due to delay or an error condition, from commanded value (DISP_EN).
 - 0 Display is disabled.
 - 1 Display is enabled.

Several bits in this I²C message have latched behavior, allowing the display to inform the host of a momentary event. The display microcontroller shall latch any value change until this subaddress is read by the host, then re-evaluate the current state.

For example, DCERR is a latched bit. This diagram shows latching behavior after a momentary FPC disconnect:



In this example:

- Display detects a momentary FPC disconnect (t=1) and latches DCERR=1.
- Display generates an interrupt request (t=2), and LVDS Source Module reads the latched value (t=5)
- Display re-evaluates, determines FPC is now connected, and latches DCERR=0.
- Display generates another interrupt request (t=6), and LVDS Source Module reads the latched value (t=9)

2.3.7.2 IFS-MMI2C-SR-REQ-140615/C-0x01 Display Identification

The Display Identification message provides a mechanism to identify which kind of display is connected.

Subaddress: 0x01

Access: Read-Only

Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	Display ID (see REQ-140616)							
[1]	Subrevision							

- Display ID: ID of connected I²C Slave according to “IFS-MMI2C-SR-REQ-140616-Display Identification Table”.
- Subrevision: giving a more detailed information about evolution of connected I²C Slave module.
I²C Slaves shall increase per 0x01 the subrevision on every hardware change, display micro firmware change or any compatibility break that not drives a major (means Display ID) change.
I²C Masters should not require the use of the subrevision.
Each Display ID begins with a subrevision of 0x00.

2.3.7.3 IFS-MMI2C-SR-REQ-140616/H-Display Identification Table

This table shows which display identifier shall be sent by Generation 2 display:

Display ID	Display Type	Display Vendor	Disp. Size	Btn	Rtr	Display Orient.	Touch Panel Controller	Illumi. Strategy	Comments
0xFD*	SIMU	-	-	-	-	-	-	-	Reserved
0xFE*	SIMU	-	-	-	-	-	-	-	Reserved
0x01	SDM4	Visteon	4,2	yes	no	Landscp.	-	PWM ¹	Initial
0x02	SDM4	Visteon	4,2	no	no	Landscp.	-	PWM ¹	Initial
0x03	SDM6	Sharp	6,5	no	no	Landscp.	mXT449T	PWM ¹	Initial
0x04	SDM8	Sharp	8,0	no	no	Landscp.	mXT641T	PWM ¹	Initial
0x05	SDM10	JDI	10,1	no	no	Landscp.	mXT1188S	PWM ¹	Initial
0x06	SDM10	JDI	10,1	no	no	Portrait	mXT1188S	PWM ¹	Initial



0x07		SDM6	Sharp	6,5	no	no	Landscape	mXT449T	PWM ¹	w/ film on TP
0x08		SDM6	Sharp	6,5	no	no	Landscape	mXT449T	PWM ¹	w/ modified TP glass
0x09		SDM8	Sharp	8,0	no	no	Landscape	mXT641T	PWM ¹	w/ new TP supplier
0x0A		SDM8	Sharp	8,0	no	no	Landscape	mXT641T	PWM ¹	w/ new TP supplier and inverted TP
0x0B		SDM6	Sharp	6,5	no	no	Landscape	mXT449T	PWM ¹	w/ New Atmel Firmware
0x0C		SDM8	Sharp	8,0	no	no	Landscape	mXT641T	PWM ¹	w/ New Atmel Firmware
0x0D		SDM8	JDI	8,0	no	no	Landscape	CYAT8268X-100AS46	PWM ¹	In-cell touch
0x0E		SDM8	Sharp	8,0	no	no	Landscape	mXT641T	PWM ¹	New LCD Module w/ carryover TP
0x0F		VDM8	Sharp	8,0	no	no	Landscape	S7880	PWM ¹	Value DM8
0x10		SDM10	JDI	10,1	no	no	Portrait	CYAT8268X-100AS46	PWM ¹	In-cell touch
0x11		SDM12	Sharp	12,4	no	no	Landscape	mXT1067T	PWM ¹	initial
0x12		DM12	Sharp	12,0	no	no	Landscape	mXT1067T	PWM ¹	initial
0x13		DMD HUD0.3	tbd	0,3	no	no	Landscape	-	RAW ¹	initial
0x14		DMD HUD0.6	tbd	0,55	no	no	Landscape	-	RAW ¹	initial
0x15		TFT HUD2	tbd	1,8	no	no	Landscape	-	tbd	initial
0x16		TFT HUD3	tbd	3,1	no	no	Landscape	-	tbd	initial
0x17		IPC12	tbd	12,4	no	no	Landscape	-	tbd	initial
0x18		SDM15	Preh	15,5	no	Cntr	Portrait	mXT2912TD	PWM ¹	initial
0x19		SDM10	JDI	10,1	no	no	Landscape	CYAT8268X-100AS46	PWM ¹	In-cell touch
0x1A		MD23	JDI	23,4	no	no	Landscape	tbd	PWM ¹	initial
0x1B		SDM15	JDI	15,5	no	no	Landscape	tbd	PWM ¹	initial
0x1C		DM12	Sharp	12,0	no	no	Portrait	tbd	PWM ¹	initial
0x1D		SDM15	JDI	15,5	no	no	Portrait	tbd	PWM ¹	initial

Note: Each display (ex. SDM6) may have multiple variants, each with a different display identifier. This is because the variants have physical differences that require e.g. a different touch calibration file.

Note*: Display IDs 0xFD and 0xFE don't need to be implemented by suppliers. However shall not cause any problems.

Note 1: For illumination strategy:

- in case of "PWM" use requirement for 0x02 LCD Backlight PWM Value (see "IFS-MMI2C-SR-REQ-140617")
 - in case of "ENC" use requirement "0x09 Encoded Backlight brightness Value" (see "IFS-MMI2C-SR-REQ-312336").
 - in case of "RAW" use requirement "0x91 Light Ambient Sensor RAW Value" (see "IFS-MMI2C-SR-REQ-323568").
- Please keep in mind, this a proprietary, not supported and private interface and not recommended to use!

**2.3.7.4 IFS-MMI2C-SR-REQ-140617/B-0x02 LCD Backlight PWM Value**

The LCD Backlight PWM message contains the brightness information for a 10 bit display backlight PWM generator ~~and an invalid bit~~. The PWM generator should use the complete range and resolution of 1024 steps with 0x000 = off and 0x3FF = 100% on. ~~Missing messages are handled like Invalid bit is set.~~

Subaddress: 0x02

Access: Read-Write

Default Value: {0x00, 0x00}

	7	6	5	4	3	2	1	0
[0]	BL_PWM[7:0]							
[1]	INVALID	-	-	-	-	-	BL_PWM[9:8]	

The SDM shall set a **default value** of ~~(0x155)0x00~~ to the PWM message until set by the LVDS Source Module.

Display illumination shall be turned on/off with display enable/disable (DISP_EN).

Reference Illumination Specification for how to use.

2.3.7.5 IFS-MMI2C-SR-REQ-140618/B-0x03 Display Scanning

The Display Scanning message provides a mechanism to control the LCD scanning direction.

Subaddress: 0x03

Access: Read-Write

Default Value: 0x00

	7	6	5	4	3	2	1	0
[0]	-	-	-	-	-	-	VSD	HSD

- VSD: Vertical Scanning Direction.
 - 0 Top to Bottom
 - 1 Bottom to Top (engineering test-use only)
- HSD: Horizontal Scanning Direction
 - 0 Left to Right
 - 1 Right to Left (engineering test-use only)

Display shall adjust the VRV / HRV pins on the LCD panel according to the value in this subaddress.

Display supplier shall ensure that video is oriented correctly, with default value 0x00, when the display is installed in the vehicle. LVDS Source Module is not responsible to set this subaddress based on the orientation of the LCD Panel. The capability is provided only for engineering test.

2.3.7.6 IFS-MMI2C-SR-REQ-140619/C-0x04 Display Enable

The Display Enable message provides a mechanism for the I²C Master to tell the I²C Slave to enable the display output.

Subaddress: 0x04

Access: Read-Write

Default Value: 0x00

	7	6	5	4	3	2	1	0
[0]	-	-	-	-	-	-	TSC_EN	DISP_EN

- TSC_EN: Touch Screen Controller Enable
 - 0 Command touch screen controller disabled
 - 1 Command touch screen controller enabled



- DISP_EN: Display Enable.
Note: This controls both the LCD Panel and the LCD Backlight.
0 Command display disabled
1 Command display enabled

This subaddress sets and reports the commanded status. The actual status (TSC_ST / DISP_ST) may be different, due to delay or an error condition.

The I²C Master shall not attempt to enable unless it is driving a valid pixel clock and video signal.

If the I²C Slave detects a loss of LOCK while enabled, the I²C Slave shall take any action necessary to prevent visible video problems. This may include disabling the backlight. If LOCK is re-established the I²C Slave shall take any steps necessary to resume showing video. This may include reset of the LCD panel and re-enabling the backlight.

If the Enable Display Output bit is set to enabled during a controlled shutdown the I²C Slave shall ignore this bit and complete the shutdown.

2.3.7.7 IFS-MMI2C-SR-REQ-140620/C-0x05 Display Shutdown

The Display Shutdown message provides a mechanism for the I²C Master to tell the I²C Slave that it will remove power from the I²C Slave and it should perform a controlled shutdown.

Subaddress: 0x05
Access: Read-Write
Default Value: 0x00

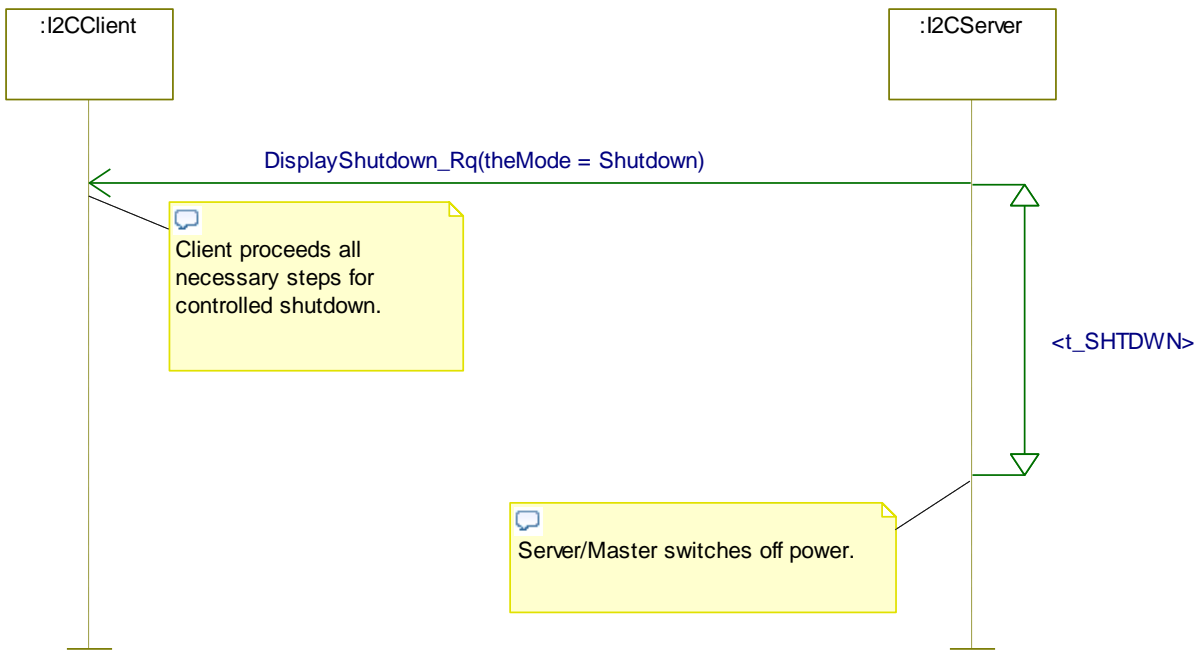
	7	6	5	4	3	2	1	0
[0]	-	-	-	-	-	-	-	SHDWN

- SHDWN: Display Shutdown
0 Normal operation.
1 Command display module to perform controlled shutdown.

After sending a controlled shutdown request, the I²C Master shall not remove power or stop driving video signal (including pixel clock) before t_{SHTDWN} expires. After the timer expires, the I²C Master shall remove power.

During an uncontrolled shutdown (i.e. battery removal, etc.) t_{SHTDWN} does not apply.

To enable function again, the I²C Master must perform the normal power initialization sequence.



2.3.7.8 IFS-MMI2C-SR-REQ-140621/B-0x06 Button Backlight PWM Value

The Display Button Backlight PWM message contains the brightness information for an 8-bit display backlight PWM generator and an invalid bit. The PWM generator should use the complete range and resolution of 256 steps with 0x00 = off and 0xFF = 100% on. ~~Missing messages are handled like Invalid bit is set.~~

Subaddress: 0x06
Access: Read-Write
Default Value: 0x00



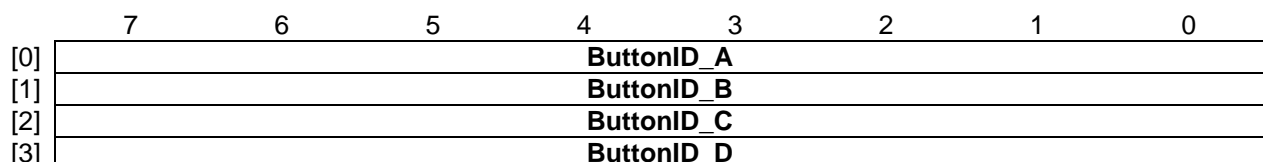
- BL_PWM: Button Backlight PWM
Value of the 8-bit PWM generator where 0x00 = fully off and 0xFF = fully on.

The SDM shall set a **default value** of ~~(0xFF)~~0x00 to the PWM message until set by the LVDS Source Module.
Button illumination shall be independent from the display enable/disable (DISP_EN).
Reference Illumination Specification for how to use.

2.3.7.9 IFS-MMI2C-SR-REQ-140622/B-0x07 Button Status

The Button Status message provides a mechanism to transmit button state status's back to the LVDS Source Module.

Subaddress: 0x07
Access: Read-Only
Default: n/a





[4]	ButtonCoding_A	ButtonCoding_B	ButtonCoding_C	ButtonCoding_D
-----	----------------	----------------	----------------	----------------

* Reference Input Translation Matrix for ButtonID values. Reference "LVDS Button SPSS" for how to use Button ID messages and Button Coding messages.

The SDM shall report the state of each button as defined above. There shall be either a default value of '0' if button is not pressed, or a single bit with a value of '1' for the proper button state.

If multiple buttons are pressed at the same time, the SDM shall report the appropriate states for each button (concurrent button presses are allowed).

Button debounce time shall be set to $t_{\text{button_pressed}}$ before the state is allowed to change.

State changes (not pressed to pressed & pressed to not pressed) shall be held for a minimum of $t_{\text{button_pressed}}$ before the state is allowed to change again (hysteresis).

Hint: $t_{\text{button_pressed}}$ is define in requirement "BUTTONv3-TMR-REQ-133003-T_reaction_time (I2C)" in Button SPSS.

2.3.7.10 IFS-MM12C-SR-REQ-324135/A-0x08 Rotary Status

The Rotary Status message provides a mechanism to transmit rotary turning information and status back to the I²C Master. The Display Identification table indicates which display modules support this feature.

Subaddress: 0x08

Access: Read-Only

Default: n/a

	7	6	5	4	3	2	1	0
[0]	-	-	-	-	MT_CK	ERR_CK	PUSH_CK	HOR_CK
[1]	-	-	-	-	DETENTS_CK [3:0]			
[2]	-	-	-	-	MT_LK	ERR_LK	PUSH_LK	HOR_LK
[3]	-	-	-	-	DETENTS_LK [3:0]			
[4]	-	-	-	-	MT_RK	ERR_RK	PUSH_RK	HOR_RK
[5]	-	-	-	-	DETENTS_RK [3:0]			

- HOR_CK: Center Knob Hand On Ring

This bit defaults clear, and is set when the user puts her/his hand onto the ring.

0 Untouched

1 Hand on Ring

- PUSH_CK: Center Knob Rotary pushed

This bit defaults clear, and is set when the user pushed the rotary.

0 Rotary released

1 Rotary pushed

- ERROR_CK: Center Knob Error on rotary

This bit defaults clear, and is set when a rotary error is detected.

0 Rotary ok

1 Rotary error or rotary unavailable

- MT_CK: Center Knob Middle Touched

This bit defaults clear, and is set when the user touches in the middle/center of the ring.

0 Untouched

1 Center/Middle of knob touched

- DETENTS_CK: Center Knob cumulated amount of rotary detents (steps)

These 4 Bits showing cumulated amount of rotary turning detents since last read of I2C Master.



Please keep in mind 0x7 = "0"

0x0-0x06	-7..-1	(7 detents in direction to left up to 1 detent in direction to left)
0x7	0	(inactive, means no detents)
0x8-0xD	+1..+7	(7 detents in direction to right up to 1 detent in direction to right)
0xE	Reserved	
0xF	Invalid	

- HOR_LK: Left Knob Hand On Ring

This bit defaults clear, and is set when the user puts her/his hand onto the ring.

0	Untouched
1	Hand on Ring

- PUSH_LK: Left Knob Rotary pushed

This bit defaults clear, and is set when the user pushed the rotary.

0	Rotary released
1	Rotary pushed

- ERROR_LK: Left Knob Error on rotary

This bit defaults clear, and is set when a rotary error is detected.

0	Rotary ok
1	Rotary error or rotary unavailable

- MT_LK: Left Knob Middle Touched

This bit defaults clear, and is set when the user touches in the middle/center of the ring.

0	Untouched
1	Center/Middle of knob touched

- DETENTS_LK: Left Knob cumulated amount of rotary detents (steps)

These 4 Bits showing cumulated amount of rotary turning detents since last read of I2C Master.

Please keep in mind 0x7 = "0"

0x0-0x06	-7..-1	(7 detents in direction to left up to 1 detent in direction to left)
0x7	0	(inactive, means no detents)
0x8-0xD	+1..+7	(7 detents in direction to right up to 1 detent in direction to right)
0xE	Reserved	
0xF	Invalid	

- HOR_RK: Right Knob Hand On Ring

This bit defaults clear, and is set when the user puts her/his hand onto the ring.

0	Untouched
1	Hand on Ring

- PUSH_RK: Right Knob Rotary pushed

This bit defaults clear, and is set when the user pushed the rotary.

0	Rotary released
1	Rotary pushed

- ERROR_RK: Right Knob Error on rotary

This bit defaults clear, and is set when a rotary error is detected.

0	Rotary ok
1	Rotary error or rotary unavailable

- MT_RK: Right Knob Middle Touched

This bit defaults clear, and is set when the user touches in the middle/center of the ring.

0	Untouched
1	Center/Middle of knob touched



- DETENTS_RK: Right Knob cumulated amount of rotary detents (steps)

These 4 Bits showing cumulated amount of rotary turning detents since last read of I2C Master.

Please keep in mind 0x7 = "0"

0x0-0x06	-7...-1	(7 detents in direction to left up to 1 detent in direction to left)
0x7	0	(inactive, means no detents)
0x8-0xD	+1...+7	(7 detents in direction to right up to 1 detent in direction to right)
0xE	Reserved	
0xF	Invalid	

2.3.7.11 IFS-MMI2C-SR-REQ-140623/C-0x30 Interrupt Status Register

The Interrupt Status message provides a mechanism to check the reason of pulling the interrupt line. For that the LVDS Source Module requests this message to transmit the interrupt reason back to the LVDS Source Module.

Subaddress: 0x30

Access: Read-Only

Default: n/a

	7	6	5	4	3	2	1	0
[0]	-	-	-	-	INT_ROT	INT_TCH	INT_BTN	INT_ERR

- INT_TCH: Touch Interrupt
Mirrors Atmel CHG signal.
1 CHG is asserted
0 CHG is deasserted
Returns =0 if the display does not support touch.
- INT_BTN: Button Interrupt
Set on button event: press, release, or repeated transmission.
Cleared on reading subaddress 0x07.
Returns =0 if the display does not support buttons.
- INT_ERR: Display Status Interrupt
Set on display status change; any bit in subaddress 0x00 changing 0->1 or 1->0.
Cleared on reading subaddress 0x00.
- INT_ROT: Rotary Interrupt
Set on Rotary event; any change in bit in subaddress 0x08 changing 0->1 or 1->0 or change in DETENTS for any Rotary Knob.
Cleared on reading subaddress 0x08.
Returns =0 if the display does not support any rotary.

The display shall generate an interrupt request whenever an interrupt-generating event occurs. An interrupt-generating event is defined as any event that causes a bit in this register to transition from 0 -> 1.

Note: The LVDS chipset does not mirror interrupt status; it only asserts INTB on a falling-edge of INTB_IN. This system uses an edge-triggered interrupt request. Refer to REQ-197941 for requirements about driving INTB_IN to make an interrupt request.

2.3.7.12 IFS-MMI2C-SR-REQ-140624/C-0x31 Core Assembly FPN

The I²C Slave Core Assembly message provides a mechanism to transmit a Ford Part Number back to the I²C Master.

Subaddress: 0x31

Access: Read-Only

Default: n/a



	7	6	5	4	3	2	1	0
[0]	Core Assembly character[0]							
...	...							
[24]	Core Assembly character[24]							

- Core Assembly: Released (or prototype) Ford Part Number
Null-terminated string. For example "H1BT-14F180-FA".
Maximum length 24 characters plus NULL.

The I²C Master shall read a maximum of 25 bytes, be robust to receiving non-ASCII bytes, and be robust to receiving non-NULL terminated data.

If the I²C Slave is not released with this kind of Ford Part Number, the I²C Slave shall indicate that the subaddress is unsupported as described in REQ-140565. In this case the I²C Slave would leave SDA undriven resulting in Data = 0xFF.

2.3.7.13 IFS-MMI²C-SR-REQ-140625/C-0x32 Delivery Assembly FPN

The Delivery Assembly message provides a mechanism to transmit a Ford Part Number back to the I²C Master.

Subaddress: 0x32
Access: Read-Only
Default: n/a

	7	6	5	4	3	2	1	0
[0]	Delivery Assembly FPN character[0]							
...	...							
[24]	Delivery Assembly FPN character[24]							

- Delivery Assembly FPN: Released (or prototype) Ford Part Number
Null-terminated string. . For example "H1BT-18B955-FA"
Maximum length 24 characters plus NULL.

The I²C Master shall read a maximum of 25 bytes, be robust to receiving non-ASCII bytes, and be robust to receiving non-NULL terminated data.

If the I²C Slave is not released with this kind of Ford Part Number, the I²C Slave shall indicate that the subaddress is unsupported as described in REQ-140565. In this case the I²C Slave would leave SDA undriven resulting in Data = 0xFF.

2.3.7.14 IFS-MMI²C-SR-REQ-140626/C-0x33 Software FPN

The Software Part Number message provides a mechanism to transmit a Ford Part Number back to the I²C Master.

Subaddress: 0x33
Access: Read-Only
Default: n/a

	7	6	5	4	3	2	1	0
[0]	Software FPN character[0]							
...	...							
[24]	Software FPN character[24]							

- Software FPN: Released (or prototype) Ford Part Number
Null-terminated string. For example "H1BT-14D358-FA"
Maximum length 24 characters plus NULL.



The I²C Master shall read a maximum of 25 bytes, be robust to receiving non-ASCII bytes, and be robust to receiving non-NULL terminated data.

If the I²C Slave is not released with this kind of Ford Part Number, the I²C Slave shall indicate that the subaddress is unsupported as described in REQ-140565. In this case the I²C Slave would leave SDA undriven resulting in Data = 0xFF.

2.3.7.15 IFS-MMI2C-SR-REQ-140627/C-0x34 Serial Number

The Serial Number message provides a mechanism to transmit an electronic serial number back to the I²C Master.

Subaddress: 0x34
Access: Read-Only
Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	Serial Number character[0]							
...	...							
[25]	Serial Number character[25]							

- Serial Number:
Null-terminated string.
Maximum length 24 characters plus NULL.

Note: This specification contains no functional requirement about the format of the serial number.

The I²C Master shall read a maximum of 25 bytes, be robust to receiving non-ASCII bytes, and be robust to receiving non-NULL terminated data.

If the I²C Slave contains no serial number, the I²C Slave shall indicate that the subaddress is unsupported as described in REQ-140565. In this case the I²C Slave would leave SDA undriven resulting in Data = 0xFF.

2.3.7.16 IFS-MMI2C-SR-REQ-140628/C-0x35 Main Calibration Data FPN

The Main Calibration Data message provides a mechanism to transmit a Ford Part Number back to the I²C Master.

Subaddress: 0x35
Access: Read-Only
Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	Main Calibration Data FPN character[0]							
...	...							
[24]	Main Calibration Data FPN character[24]							

- Main Calibration Data FPN: Released (or prototype) Ford Part Number
Null-terminated string. No example provided.
Maximum length 24 characters plus NULL.

The I²C Master shall read a maximum of 25 bytes, be robust to receiving non-ASCII bytes, and be robust to receiving non-NULL terminated data.

If the I²C Slave is not released with this kind of Ford Part Number, the I²C Slave shall indicate that the subaddress is unsupported as described in REQ-140565. In this case the I²C Slave would leave SDA undriven resulting in Data = 0xFF.



2.3.7.17 IFS-MMI2C-SR-REQ-307237/A-0x40 Image Adjustment

The Image Adjustment message provides a mechanism for the I²C Master to tell I²C Slave where to move the image and increase/decrease brightness of the image (e.g. related to user settings).

Subaddress: 0x40

Access: Read-Write

Default Value: 0xFFFFFFFF

	7	6	5	4	3	2	1	0
[0]	Horizontal Position							
[1]	Vertical Position							
[2]	Rotation							
[3]	Brightness							

- Horizontal Position: coordinate in steps of horizontal position of the image
0x00-0xFD: valid range
0xFE: invalid
0xFF: no change (of horizontal position)
- Vertical Position: coordinate in steps of vertical position of the image
0x00-0xFD: valid range
0xFE: invalid
0xFF: no change (of vertical position)
- Rotation: number of steps to rotate image
0x00-0xFD: valid range
0xFE: invalid
0xFF: no change (of rotation)
- Brightness: number of steps to adjust brightness
0x00-0xFD: valid range
0xFE: invalid
0xFF: no brightness change

2.3.7.18 IFS-MMI2C-SR-REQ-306750/A-0x41 Supplier Precalc Low Warping Table

The Supplier Precalculated Low Warping Table message provides a mechanism to get a data for distortion adjustment of the image from I²C Slave.

Subaddress: 0x41

Access: Read-Only

Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	Check field							
[1]								
[2]								
[3]								
[4]	Number of Bytes of Data							
[5]								
[6]								
[7]								
[8]	Data							
[...]								
[...]								

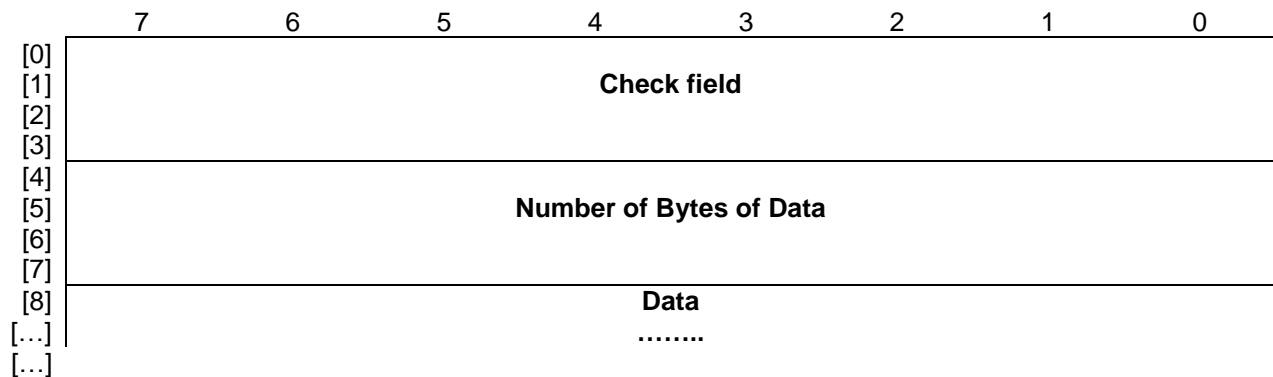


- Check field:
Containing data for checking if content of data field is valid (XPY format)
- Number of Bytes of Data:
Length of following data area in bytes
- Data:
Table of warping/distortion data

2.3.7.19 IFS-MMI2C-SR-REQ-307232/A-0x42 Supplier Precalc Medium Warping Table

The Supplier Precalculated Medium Warping Table message provides a mechanism to get a data for distortion adjustment of the image from I²C Slave.

Subaddress: 0x42
Access: Read-Only
Default Value: n/a

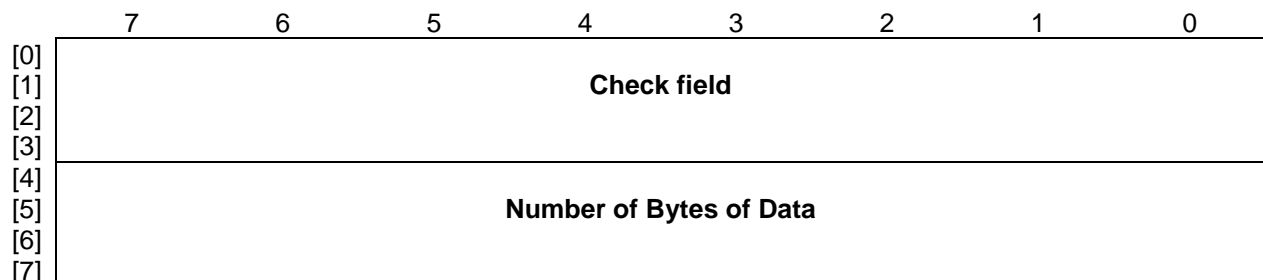


- Check field:
Containing data for checking if content of data field is valid (XPY format)
- Number of Bytes of Data:
Length of following data area in bytes
- Data:
Table of warping/distortion data

2.3.7.20 IFS-MMI2C-SR-REQ-307233/A-0x43 Supplier Precalc High Warping Table

The Supplier Precalculated High Warping Table message provides a mechanism to get a data for distortion adjustment of the image from I²C Slave.

Subaddress: 0x43
Access: Read-Only
Default Value: n/a





[8]	Data
[...]
[...]	

- Check field:
Containing data for checking if content of data field is valid (XPY format)
- Number of Bytes of Data:
Length of following data area in bytes
- Data:
Table of warping/distortion data

2.3.7.21 IFS-MMI2C-SR-REQ-307234/A-0x44 Supplier EOL Low Warping Table

The Supplier End Of Line Low Warping Table message provides a mechanism to get a data for distortion adjustment of the image from I²C Slave.

Subaddress: 0x44
Access: Read-Only
Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	Check field							
[1]								
[2]								
[3]								
[4]	Number of Bytes of Data							
[5]								
[6]								
[7]								
[8]	Data							
[...]								
[...]								

- Check field:
Containing data for checking if content of data field is valid (XPY format)
- Number of Bytes of Data:
Length of following data area in bytes
- Data:
Table of warping/distortion data

2.3.7.22 IFS-MMI2C-SR-REQ-307235/A-0x45 Supplier EOL Medium Warping Table

The Supplier End Of Line Medium Warping Table message provides a mechanism to get a data for distortion adjustment of the image from I²C Slave.

Subaddress: 0x45
Access: Read-Only
Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	Check field							
[1]								
[2]								
[3]								



[4]	Number of Bytes of Data
[5]	
[6]	
[7]	
[8]	Data
[...]
[...]	

- Check field:
Containing data for checking if content of data field is valid (XPY format)
- Number of Bytes of Data:
Length of following data area in bytes
- Data:
Table of warping/distortion data

2.3.7.23 IFS-MMI2C-SR-REQ-307236/A-0x46 Supplier EOL High Warping Table

The Supplier End Of Line High Warping Table message provides a mechanism to get a data for distortion adjustment of the image from I²C Slave.

Subaddress: 0x46
Access: Read-Only
Default Value: n/a

	7	6	5	4	3	2	1	0
[0]	Check field							
[1]								
[2]								
[3]								
[4]	Number of Bytes of Data							
[5]								
[6]								
[7]								
[8]	Data							
[...]								
[...]								

- Check field:
Containing data for checking if content of data field is valid (XPY format)
- Number of Bytes of Data:
Length of following data area in bytes
- Data:
Table of warping/distortion data

2.3.7.24 IFS-MMI2C-SR-REQ-323568/A-0x91 Light Ambient Sensor RAW Value

Note: Only applicable for I²C Slaves using “RAW” illumination strategy!

The RAW values light sensor message contains an 8-Bit raw value and 4 values showing a status. Since this is not a recommended strategy to have the illumination strategy isolated and proprietary in receiving ECU, this is not fully supported or described.

Subaddress: 0x91
Access: Read-Write



Default Value: { 0x00, 0x0 }

	7	6	5	4	3	2	1	0
[0]	BL_RAW[7:0]							
[1]	-	-	-	-	-	-	BL2_RAW[1:0]	

Note: It is highly recommended NOT to use this message!

- BL_RAW: RAW value of sensor value
- BL2_RAW: status of sensor
 - 0x0 Null
 - 0x1 Low
 - 0x2 High
 - 0x3 Faulty

2.3.7.25 IFS-MMI2C-SR-REQ-324467/A-0x92 Forward Collision Warning Status

The Forward Collision Warning Status message provides a mechanism to transmit if a Forward Collision Warning event occurs to the I²C Slave.

Subaddress: 0x92

Access: Read-Write

Default: n/a

	7	6	5	4	3	2	1	0
[0]	-	-	-	-	-	-	-	FCW_Flag

- FCW_Flag: Forward Collision Warning Flag

This bit defaults clear, and is set if a Forward Collision warning event occurs.

- 0 Off FCW visible warning event is not active
- 1 On FCW visible warning event is active

2.3.7.26 IFS-MMI2C-SR-REQ-140629/B-I2C Reserved Subaddresses

The read and write messages at subaddress 0xB0-0xFF shall be reserved for internal supplier uses.



3 Appendix A: Definitions / Acronyms

DES – LVDS Deserializer
DM – Display Module
DMD – Digital Micromirror Device
DTC – Diagnostic Trouble Code
ESN – Electronic Serial Number
FPC – Flexible Printed Circuit
FPN – Ford Part Number
Gen2 Cameras – e.g. Digital Rear View Camera
HUD – Head Up Display
IPC – Instrument Panel Cluster
IPMB – Image Processing Module B, Rear View Camera
ISR – Interrupt Status Register
SDM – Slim Display Module
SER – LVDS Serializer
TFT – Thin Film Transistor
TSC – Touch Screen Controller



4 Appendix B: Reference Documents

Reference #	Document Title
1	Button SPSS
2	Bezel Diagnostics SPSS
3	Hardware specification of related Module e.g. SDM, IPC, HUD
4	NXP UM102104, I2C-bus specification and user manual
5	Atmel mXT540E Protocol Guide
6	Atmel mXT641T Protocol Guide
7	TI AN-2173 I2C Communication Over FPD-Link III with Bidirectional Control Channel (Application Note)
8	TI SNLS407 DS90UB925Q (User's Guide)
9	TI SNLS422 DS90UB926Q (User's Guide)
10	Cypress Automotive TrueTouch Touch Screen Controller Technical Reference Manual

The requirements of the documents listed in the reference table above, of the latest revision level, form a part of this Engineering Specification