Application Note

Astra™ Machina Foundation Series - UART

Abstract: This document provides an overview of the UART functionality in the Astra Machina Foundation Series, detailing UART timing, pinmux configurations, baud rate calculations, and programming flow to facilitate serial communication with SL-Series core modules.

  | PN: 506-001506-01 Rev B

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1. Overview

The Astra™ Machina Foundation Series offers evaluation-ready kits that facilitate quick and straightforward prototyping with the Synaptics SL-Series of embedded Linux® and Android™ processors. Featuring a modular design, these kits include interchangeable core compute modules, a standard I/O board, and daughter cards for connectivity, debugging, and various I/O configurations. Additionally, the Astra Machina Foundation Series features UART(x) technology.

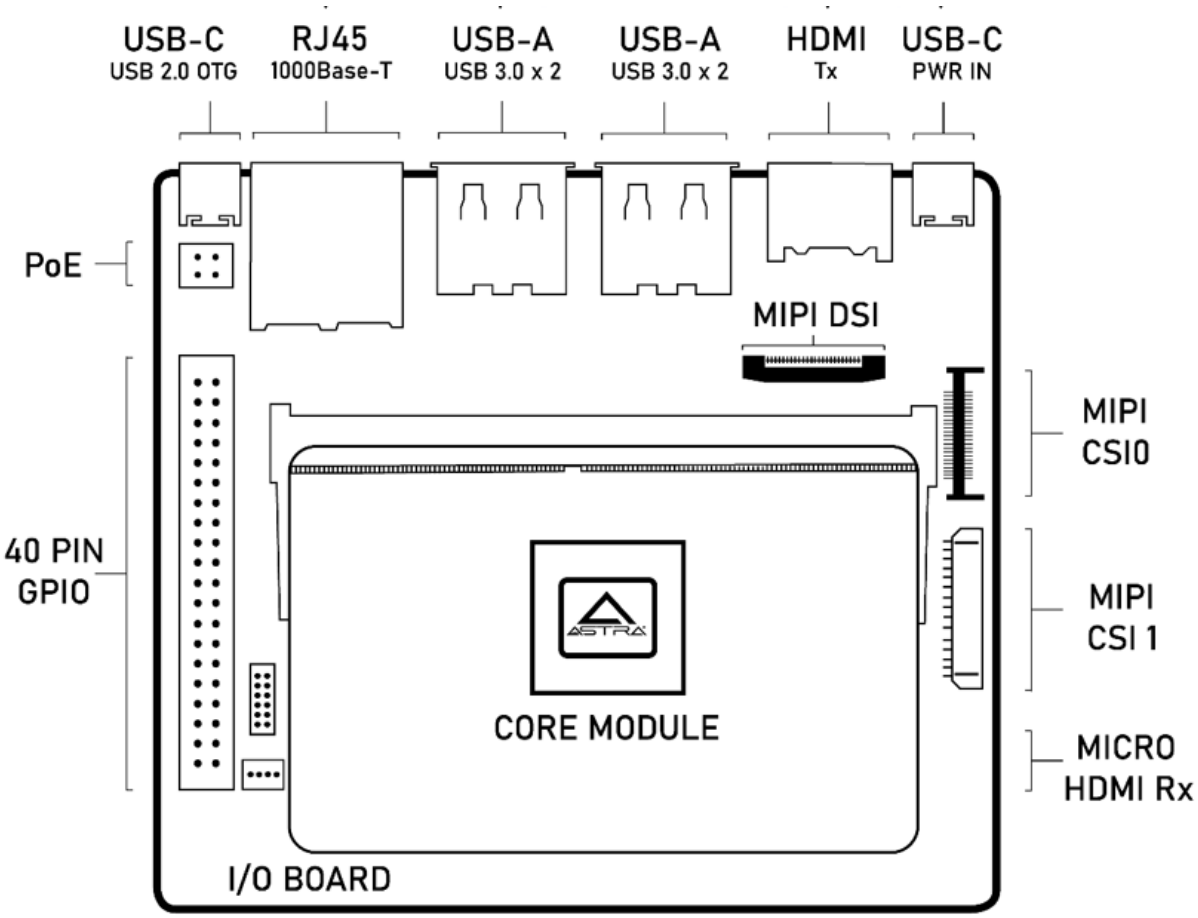

Figure 1. Astra Machina Foundation Series overview

2. UART(x) Introduction

Universal Asynchronous Receiver/Transmitter (UART) is a peripheral device for asynchronous serial communication in which the data format and transmission speeds are configurable.

2.1. UART(x) Timing

Table 1. SL16xx UART Timing

Symbol	Parameter	Condition	Min	Typ[1]	Max	Units
—	Tx bit width	±5%	—	8.68	—	µs
—	Rx bit width	±5%	—	8.68	—	µs

1. The typical values are for 115.2 kbaud

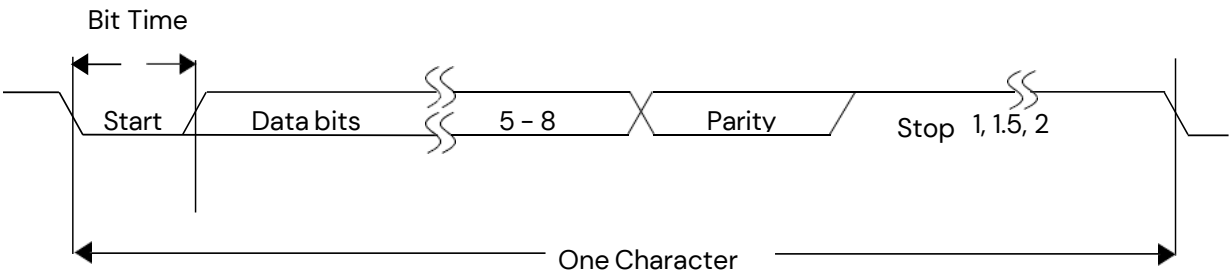

Figure 2. Serial Data Format

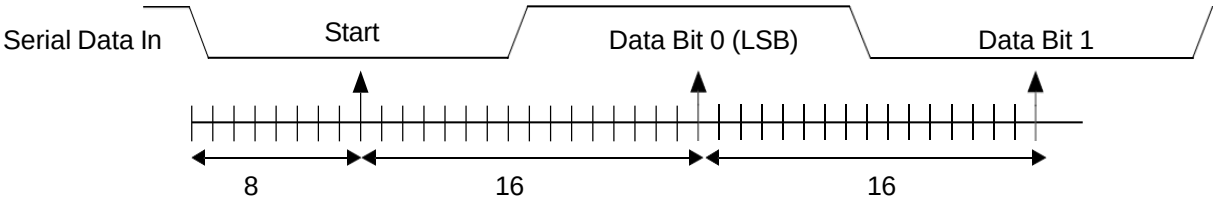

Figure 3. Receiver Serial Data Sample Points

2.2. SL16(xx) UART(x) Clock Sources Information

Table 2. SL16xx UART Clock Source

UART(x)	SL1680 Clk source	SL1640 Clk source	SL1620 Clk source
UART(0)	25MHz	25MHz	25MHz
UART(1)	100MHz	100MHz	100MHz

2.3. Baud Rate Calculation

SL16xx Series UART Interface support all Baud Rates. However, SL16xx Series application set and verified at 115.2K Baud.

2.3.1. Baud rate

Baud rate = (serial clock freq) / (16 * divisor) where divisor is integer

The baud rate is determined by the following factors:

Serial clock operating frequency (sclk in Asynchronous serial clock implementation)

- The desired baud rate.
- The baud rate generator divisor value, DIVISOR (composed of DLH & DLL registers).
- The acceptable Baud-rate error, %ERROR.

The equation to calculate the baud rate is as follows:

$$\text{Baud Rate} = \frac{\text{Serial Clock Operating Frequency}}{(16 \times \text{DIVISOR})}$$

Where,

DIVISOR – Number (in hexadecimal) to program the DLL and DLH.

Serial clock frequency – Frequency at clk source of UART from table 2 above, DIVISOR can be calculated as:

$$\text{DIVISOR} = \frac{\text{Serial Clock Operating Frequency}}{(16 \times \text{Baud Rate})}$$

Also, from Equation above, it can also be shown that:

Serial clock frequency = Baud Rate × 16 × DIVISOR

The Error between the Baud rate and Baud rate (selected) is given as:

$$\text{Percentage ERROR} = \frac{|\text{Baud Rate} - \text{Baud Rate (selected)}|}{\text{Baud Rate}} \times 100$$

2.3.2. Maximum sampling rate

Maximum speed = (serial clock freq) / (16 * divisor) where divisor is 1 and serial clock is 100MHz of UART1.

Therefore, Maximum speed is: 100MHz / (16*1) = 6.25Mbps

2.4. UART(x) Base Address Register Information

Table 3. SL16xx System Manager I/O Address Register Map

UART(x)	Base Address	Device SL16xx
UART(0)	0xF7FC_D000	SL1680, SL1640
UART(1)	0xF7FC_E000	SL1680,SL1640

Table 4. SL16xx Peripheral Base Address Register Memory Map

UART(x)	Base Address	Device SL16xx
UART 0	0xF7E8_1000	SL1680
UART 0	0xF7E8_1000	SL1640
UART 0	0xF7E8_1400	SL1620
UART 1	0xF7E8_1800	SL1620

3. SL16(xx) UART Pinmux

3.1. SL1680 – UART Pinmux

Table 5. SL1680 SM UART Pinmux

Pin #	Mode 0	Mode 1	Mode 5
AW51	SM_URTO_RXD	—	—
AW55	SM_URTO_TXD	—	—
AB60	—	SM_URT1_RXD	—
AG59	—	SM_URT1_TXD	—
AY59	—	—	URT2_RXD
AT59	—	—	URT2_TXD

Table 6. SL1680 SoC UART Pinmux

Pin #	Mode 4
W47	URT3_RXD
R51	URT3_TXD

3.2. SL1640 – UART Pinmux

Table 7. SL1640 SM UART Pinmux

Pin #	Mode 0	Mode 1	Mode 5
AK28	SM_URTO_RXD	—	—
AL28	SM_URTO_TXD	—	—
AD31	—	SM_URT1_RXD	—
AC32	—	SM_URT1_TXD	—

Table 8. SL1640 SoC UART Pinmux

Pin #	Mode 0	Mode 4	Mode 5
AL30	—	—	URT2A_RXD
AK32	—	—	URT2A_TXD
B5	—	URT2B_RXD	—
B6	—	URT2B_TXD	—

3.3. SL1620 – UART Pinmux

Table 9. SL1620 UART Pinmux

Pin #	Mode 0	Mode 2	Mode 3
C22	—	URT1A_RXD	—
C23	—	URT1A_TXD	—
F14	URTOA_RXD	—	—
B15	URTOA_TXD	—	—
B25	—	—	URT1B_TXD
B26	—	—	URT1B_RXD
B13	—	URTOB_RXD	—
C12	—	URTOB_TXD	—

4. SL16(xx) UART Program Flow

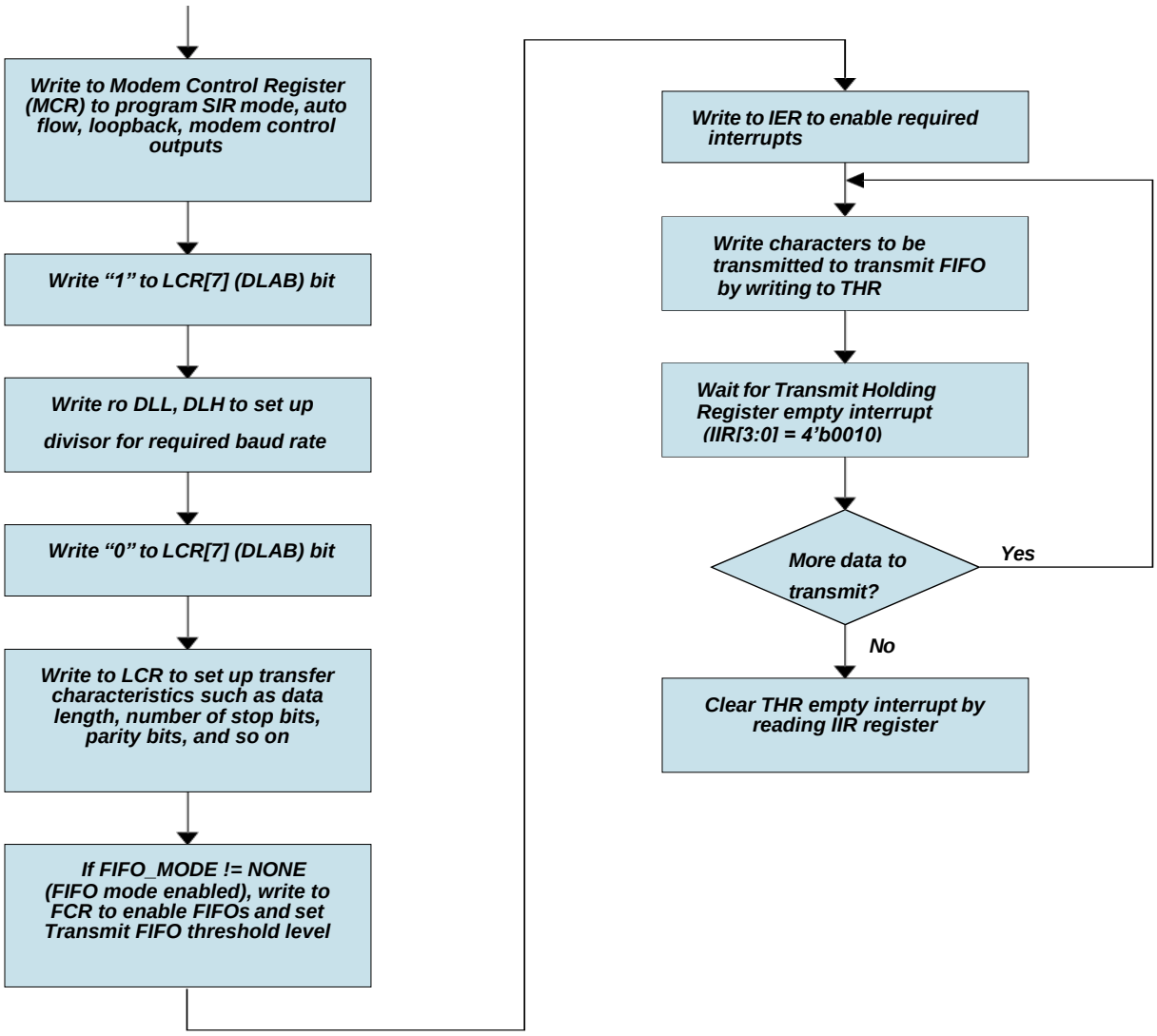

Figure 4. Flowchart UART Transmit Programming Example

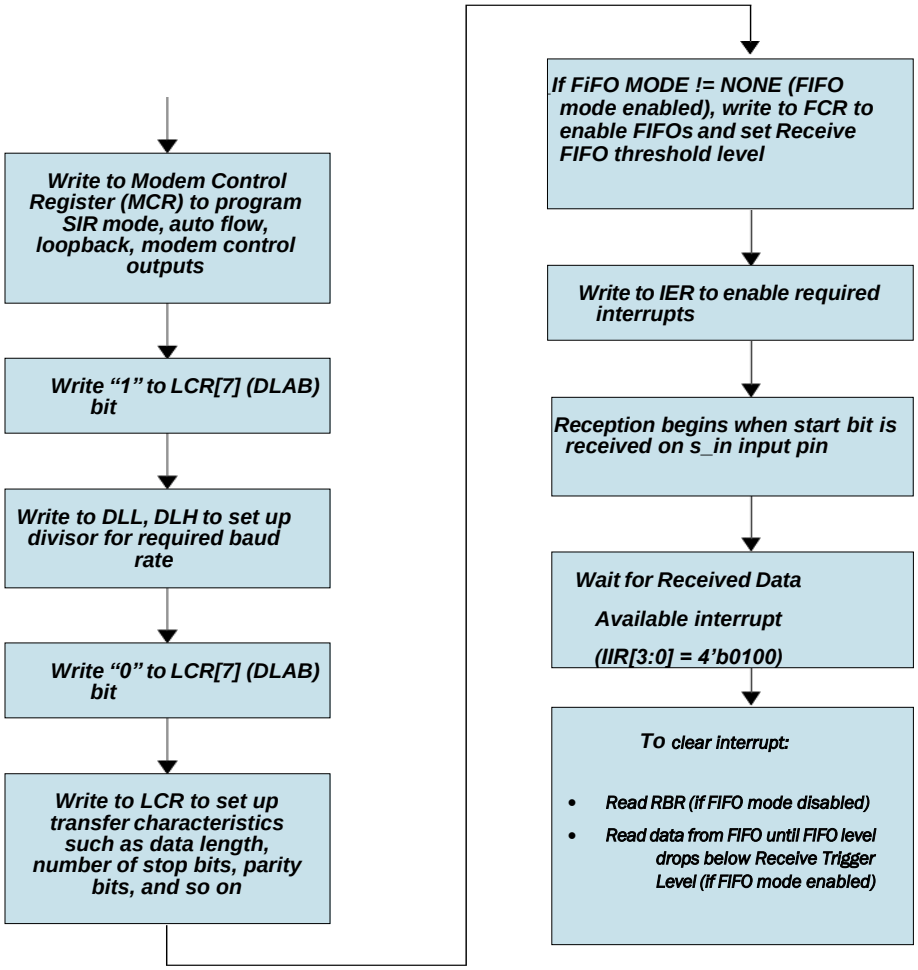

Figure 5. Flowchart UART Receive Programming Example

5. References

- *Astra Machina Foundation Series Quick Start Guide* (PN: 511-001404-01)
- *Astra Machina SL1640 Developer Kit User Guide* (PN: 511-001405-01)
- *Astra Machina SL1620 Developer Kit User Guide* (PN: 511-001407-01)
- *Astra Machina SL1680 Developer Kit User Guide* (PN: 511-001403-01)

6. Revision History

Revision	Description
A	Initial release
B	Minor update to latest template.

PN: 506-001506-01 Rev B