Application Note

Astra™ Machina Foundation Series TWSI Application Note

Abstract: This application note provides detailed connection guidelines for TWSI with the SL1620, SL1640, and SL1680 RDK.

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1. Overview

The Two-Wire Serial Interface (TWSI) is a synchronous, bidirectional communication protocol designed for low-speed peripheral communication. It is commonly used for interfacing with EEPROMs, sensors, RTCs, and other low-power peripherals on SL16x0 RDK platform. TWSI is compatible with the **Inter-Integrated Circuit (I²C)** protocol.

The SL16X0 processor provides four TWSI interfaces.

The key features:

- **Two-wire communication** (SCL: Serial Clock, SDA: Serial Data)
- Supports multiple devices on a single bus (multi-host/target architecture)
- 7-bit and 10-bit addressing modes
- Supports standard (100 kHz), fast (400 kHz), and high-speed (3.4 MHz) modes
- Built-in arbitration and collision detection for multi-host support

Note: Clock stretching is not supported.

2. TWSI Hardware Connection on SL16x0 RDK

2.1. Hardware Considerations

- **Pull-up Resistors**: Typically, **2.2kΩ** pull-up resistors are used on SDA and SCL lines.
- **Voltage Levels**: All TWSI interfaces are **1.8V level**, to connect with 3.3V or 5V targets, a level-shifter is required.

2.2. TWxA and TWxB

In SL1680 and SL1640 processors, TW1 and TW2 are available on multiple pads, such as TW1A, TW1B, TW2A, and TW2B.

- **TW1** – TW1A and TW1B are connected to the same TW1 controller but are routed through different pinmux pads.
- **TW2** – Functions the same way as TW1.

2.3. TWSI Connection of SL1680 RDK

Table 1 lists the usage of the TWSI bus of SL1680 RDK platform.

Table 1. TWSI bus usage of SL1680 RDK

I²C / TWSI Bus	Device	Part Number	Ref Des	Target Address (7-bit)	Location
SM_TW3	Current monitor for PWR_3V3	INA220	U76	0x40	SL16x0 I/O board
	Current monitor for PWR_1V8	INA220	U77	0x41	SL16x0 I/O board
	IC GPIO Expander I2C 8-bit	FXL6408UMX	U12	0x43	SL16x0 I/O board
	IC GPIO Expander I2C 8-bit	FXL6408UMX	U13	0x44	SL16x0 I/O board
	External device connects to MIPI_CSI0 connector	N/A	J206	0xXX	SL16x0 I/O board
SM_TW2B	IC REG, default 0.8V Vout/5mV Step, 6A rating, Input 6V@Max, Step-Down Convertor with I2C	TPS62870Y1QWRXSRQ1	U3	0x40	SL1680 core module
SOC_TW1B	IC REG, default 0.8V Vout/5mV Step, 6A rating, Input 6V@Max, Step-Down Convertor with I2C	TPS62870Y1QWRXSRQ1	U2	0x40	SL1680 core module
SOC_TW0	External device connects to MIPI_CSI1 connector	N/A	J207	0xXX	SL16x0 I/O board
	External device connects to MIPI_DSI connector	N/A	J208	0xXX	SL16x0 I/O board
	External device connects to 40-pin Header	N/A	J32	0xXX	SL16x0 I/O board
	Current monitor for Vcore, Vcpu, VDDM_1V1	INA3221	U75	0x40	SL1680 core module
	Current monitor for 3V3_M2, VDDM_1V8, VDDM_1V1 & 0V6	INA3221	U76	0x41	SL1680 core module

2.4. TWSI Connection of SL1640 RDK

Table 2 lists the usage of the TWSI bus of SL1640 RDK platform.

Table 2. TWSI bus usage of SL1640 RDK

I²C / TWSI Bus	Device	Part Number	Ref Des	Target Address (7-bit)	Location
SOC_TW0	External device connects to MIPI_DSI connector	N/A	J208	0xXX	SL16x0 I/O board
	External device connects to 40-pin Header	N/A	J32	0xXX	SL16x0 I/O board
	Current monitor for Vcore, Vcpu, VDDM_1V1	INA3221	U75	0x40	SL1640 core module
	Current monitor for VDDM_0V6	INA220	U76	0x41	SL1640 core module
SOC_TW1B	IC REG, default 0.8V Vout/5mV Step, 6A rating, Input 6V@Max, Step-Down Convertor with I2C	TPS62870Y1QWRXSRQ1	U2	0x40	SL1640 core module
SM_TW2	IC REG, default 0.8V Vout/5mV Step, 6A rating, Input 6V@Max, Step-Down Convertor with I2C	TPS62870Y1QWRXSRQ1	U3	0x40	SL1640 core module
SM_TW3	IC GPIO Expander I2C 8-bit	FXL6408UMX	U12	0x43	SL16x0 I/O board
	IC GPIO Expander I2C 8-bit	FXL6408UMX	U12	0x43	SL16x0 I/O board
	Current monitor for PWR_3V3	INA220	U76	0x40	SL16x0 I/O board
	Current monitor for PWR_1V8	INA220	U77	0x41	SL16x0 I/O board

2.5. TWSI Connection of SL1620 RDK

Table 3 lists the usage of the TWSI bus of SL1620 RDK platform.

Table 3. TWSI bus usage of SL1620 RDK

I²C / TWSI Bus	Device	Part Number	Ref Des	Target Address (7-bit)	Location
TW0	External device connects to MIPI_DSI connector	N/A	J208	0xXX	SL16x0 I/O board
	External device connects to 40-pin Header	N/A	J32	0xXX	SL16x0 I/O board
	USB type-C CC logic (reserved)	TUSB320IRWBR	U55	0x47 or 0x67	SL16x0 I/O board
	External device connects to LCD connector	N/A	J35	0xXX	SL1620 core module
	Current/voltage monitor for Vcore / 1.8V / 3.3V	INA3221	U9	0x40	SL1620 core module
	Current/voltage monitor for 1.2V	INA220	U4	0x45	SL1620 core module
	IC GPIO Expander	FXL6408UMX	U1	0x44	SL1620 core module
	IC GPIO Expander	FXL6408UMX	U8	0x43	SL1620 core module
TW1	IC GPIO Expander	FXL6408UMX	U12	0x43	SL16x0 I/O board
	IC GPIO Expander	FXL6408UMX	U13	0x44	SL16x0 I/O board
	Current/voltage monitor for PWR_3V3	INA220	U76	0x40	SL16x0 I/O board
	Current/voltage monitor for PWR_1V8	INA220	U77	0x41	SL16x0 I/O board
	External device connects to 40-pin Header	N/A	J32	0xXX	SL16x0 I/O board
TW2	IC REG, default 0.8V Vout/5mV Step, 6A rating, Input 5.5V@Max, Step-Down Convertor with I2C	TPS628660AYCG	U39	0x49	SL1620 core module

3. TWSI Controller Registers

Configuring TWSI requires setting up registers in the embedded system. This section lists key TWSI controller registers and the SL16x0 processor's register base address.

3.1. Generate Registers of TWSI Controller

Table 4 provides the details of the TWSI Controller registers.

Table 4. TWSI Controller registers

Offset	Name	Description
0x00	IC_CON	I2C Control Register: 6: IC_TARGET_DISABLE 5: IC_RESTART_EN 4: IC_10BITADDR_HOST 3: IC_10BITADDR_TARGET 2:1: IC_MAX_SPEED_MODE 0: IC_HOST_MODE
0x14	IC_SS_SCL_HCNT	Standard speed I2C Clock SCL High Count **I2C speed = Base_Clock / (High Count + Low Count)**
0x18	IC_SS_SCL_LCNT	Standard speed I2C Clock SCL Low Count
0x1C	IC_FS_SCL_HCNT	Fast speed I2C Clock SCL High Count
0x20	IC_FS_SCL_LCNT	Fast speed I2C Clock SCL Low Count
0x24	IC_HS_SCL_HCNT	High speed I2C Clock SCL High Count
0x28	IC_HS_SCL_LCNT	High speed I2C Clock SCL Low Count
0x7C	IC_SDA_HOLD	SDA hold time length register
0x94	IC_SDA_SETUP	I2C SDA Setup Register

3.2. TWSI Controller Base Address

Table 5 lists the base address of TWSI on each SL16x0 processor.

Table 5. Base address of TWSI registers

SoC	TWSI Controller	Base Address
SL1680	SOC_TWO	0xF7E81800
	SOC_TW1	0xF7E82000
	SM_TW2	0xF7FCB000
	SM_TW3	0xF7FCC000
SL1640	SOC_TWO	0xF7E81800
	SOC_TW1	0xF7E82000
	SM_TW2	0xF7FCB000
	SM_TW3	0xF7FCC000
SL1620	TWO	0xF7E81C00
	TW1	0xF7E82000
	TW2	0xF7E82400
	TW3	0xF7E82800

4. References

- *Astra Machina Foundation Series Quick Start Guide* (PN: 511-001404-01)
- *SL1620 Embedded IoT Processor Electrical Specification Datasheet* (PN: 505-001428-01)
- *SL1640 Embedded IoT Processor Electrical Specification Datasheet* (PN: 505-001415-01)
- *SL1680 Embedded IoT Processor Electrical Specification Datasheet* (PN: 505-001413-01)
- *Astra Machina SL1620 Developer Kit User Guide* (PN: 511-001407-01)
- *Astra Machina SL1640 Developer Kit User Guide* (PN: 511-001405-01)
- *Astra Machina SL1680 Developer Kit User Guide* (PN: 511-001403-01)

5. Revision History

Revision	Description
A	Initial release.

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