

Application Note

PRU Subsystem Features Comparison



Catalog Processors

ABSTRACT

This application report documents the feature differences between the PRU Subsystems available on different TI processors.

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1 Introduction

The Programmable Real-time Unit (PRU) is a small processor core that is tightly integrated with an IO subsystem, offering low-latency control of IO pins. The TI Sitara family of devices offer three flavors of PRU Subsystem.

1.1 PRU-ICSS: The Programmable Real-time Unit and Industrial Communication Subsystem

The Programmable Real-time Unit and Industrial Communication Subsystem (PRU-ICSS) consists of dual 32-bit RISC cores (the PRUs), shared data, instruction memories, internal peripheral modules, and an interrupt controller (INTC). The programmable nature of the PRU, along with its access to pins (IOs), events and all System-on-Chip (SoC) resources, provides flexibility in implementing fast real-time responses, specialized data handling operations, custom peripheral interfaces, and in off-loading tasks from the other processor cores of the SoC.

Devices offering the PRU-ICSS capability include AM263x, AM335x, AM437x, AM57x and K2G.

1.2 PRU_ICSSG: The Programmable Real-time Unit and Industrial Communication Subsystem - Gigabit

The Programmable Real-time Unit and Industrial Communication Subsystem - Gigabit (PRU_ICSSG) can be considered a superset of the PRU-ICSS. In addition to all PRU-ICSS features, the PRU_ICSSG adds two Auxiliary Programmable Real-Time Unit (RTU) cores, two Transmit PRU (TX_PRU) cores, broadside memories, improved event management with the task manager, data processing and data movement accelerators, and new peripherals such as PWM.

Devices offering the PRU_ICSSG capability include AM65x, AM64x and AM243x.

1.3 PRUSS: The Programmable Real-time Unit Subsystem

The Programmable Real-time Unit Subsystem (PRUSS) consists of dual 32-bit RISC cores (the PRUs), shared data, instruction memories, internal peripheral modules, and an interrupt controller (INTC). The programmable nature of the PRU cores, along with their access to pins, events and all device resources, provides flexibility in implementing fast real-time responses, specialized data handling operations, custom peripheral interfaces, and in offloading tasks from the other processor cores of the device.

Industrial Communication Subsystem features including Ethernet (MII signals and MDIO signals are not pinned out) are not supported.

Devices offering the PRUSS capability include AM62x.

1.4 PRU Subsystem Feature Comparison

Table 1-1 shows a high-level feature of the PRU subsystems.. The subsequent sections show the feature differences between each device that supports the given subsystem flavor. For a more detailed comparison, see the [PRU-ICSS/PRU_ICSSG Migration Guide](#).

Table 1-1. PRU Subsystem Feature Comparison

	Feature	PRUSS	PRU-ICSS	PRU_ICSSG
General PRU Specifications	PRU cores	Yes	Yes	Yes
	RTU_PRU (Auxiliary PRU) cores	No	No	Yes
	TX PRU (Transmit PRU) cores	No	No	Yes
	IRAM (per PRU / RTU_PRU / TX_PRU core)	Yes	Yes	Yes
	DRAM (2 DRAMs per PRU-ICSS/PRU_ICSSG)	Yes	Yes	Yes
	Shared DRAM	Yes	Yes	Yes
	INTC	Yes	Yes	Yes
General Purpose Inputs	Direct Input	Yes	Yes	Yes
	16-bit Parallel Capture	Yes	Yes	Yes
	28-bit Shift	Yes	Yes	Yes
	3 Ch. Peripheral Interface (EnDAT)	No	Device dependent	Yes
	9 Ch. Sigma Delta	No	Device dependent	Yes
General Purpose Outputs	Direct Output	Yes	Yes	Yes
	Shift out	Yes	Yes	Yes
Accelerators: Data Processing	MPY/MAC	Yes	Yes	Yes
	CRC 16/32	Yes	Device dependent	Yes
	Scratch Pad	Yes	Yes	Yes
	IPC Scratch Pad	No	No	Yes
	Broadside RAM	No	No	Yes
	BSWAP	No	No	Yes
	SUM32	No	No	Yes
	Task Manager	No	No	Yes
	Spinlock	No	No	Yes
	Filter Data Base (FDB)	No	No	Yes
Accelerators: Data Movement	XFR2VBUS	Yes	No	Yes
	PSI TX & RX	No	No	Yes
	XFR2TR	No	No	Yes
Peripherals	UART	Yes	Yes	Yes
	eCAP	Yes	Yes	Yes
	IEP	Yes	Yes	Yes
	MII_RT or MII_G_RT	No	Yes (MII)	Yes (MII/RGMII)
	MDIO	No	Yes	Yes
	SGMII	No	No	Device Dependent
	PWM	No	No	Yes

2 PRU-ICSS Feature Comparison

Table 2-1. PRU-ICSS Feature Comparison

	AM335x	AM437x		AM570x	AM571x	AM572x	AM574x	K2G	AM263x
Features	PRU-ICSS1	PRU-ICSS1	PRU-ICSS0	2x PRU-ICSS ⁽¹⁾	2x PRU-ICSS ⁽¹⁾	2x PRU-ICSS ⁽¹⁾	2x PRU-ICSS ⁽¹⁾	2x PRU-ICSS ⁽¹⁾	1x PRU-ICSS
Number of PRU cores	2	2	2	2	2	2	2	2	2
Max Frequency	200 MHz	225 MHz ⁽²⁾	225 MHz ⁽²⁾	200 MHz	200 MHz	200 MHz	200 MHz	200 MHz	200 MHz
IRAM size (per PRU core)	8 KB	12 KB	4 KB	12 KB	12 KB	12 KB	12 KB	16 KB	12 KB
DRAM size (2 DRAMs per PRU-ICSS)	8 KB	8 KB	4 KB	8 KB	8 KB	8 KB	8 KB	8 KB	8 KB
Shared DRAM size	12 KB	32 KB	0 KB	32KB	32KB	32KB	32 KB	64KB w/ ECC	32 KB
General Purpose Input (per PRU core)	Direct; or 16-bit parallel capture; or 28-bit shift	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta	Direct; or 16-bit parallel capture; or 28-bit shift	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta
General Purpose Output (per PRU core)	Direct; or Shift out	Direct; or Shift out	Direct; or Shift out	Direct; or Shift out	Direct; or Shift out	Direct; or Shift out	Direct; or Shift out	Direct; or Shift out	Direct; or Shift out
GPI Pins (PRU0, PRU1)	17, 17	13, 0	20, 20	0/21 ⁽³⁾ , 21/17	0/21 ⁽³⁾ , 21/21	21, 21	21, 21	20, 20	17, 20
GPO Pins (PRU0, PRU1)	16, 16	12, 0	20, 20	0/21 ⁽³⁾ , 21/17	0/21 ⁽³⁾ , 21/21	21, 21	21, 21	20, 20	17, 20
MPY/MAC	Y	Y	Y	Y	Y	Y	Y	Y	Y
Scratchpad	Y (3 banks)	Y (3 banks)	N	Y (3 banks)	Y (3 banks)	Y (3 banks)	Y (3 banks)	Y (3 banks)	Y (3 banks)
CRC16/32	0	2	2	2	2	2 ⁽⁴⁾	2	2	2
INTC	1	1	1	1	1	1	1	1	1
Peripherals									
UART	1	1	1	1 / not pinned out ⁽⁵⁾	1	1	1	1	1
eCAP	1	1	not pinned out	1 / not pinned out ⁽⁵⁾	1	1	1	1	1
IEP	1	1	not pinned out	1 / not pinned out ⁽⁵⁾	1	1	1	1	1
MII_RT	2	2	not pinned out	2	2	2	2	2	2
MDIO	1	1	not pinned out	1	1	1	1	1	1

- (1) The name PRU-ICSS and PRUSS are used interchangeably throughout the AM57xx and K2G documentation to describe the Programmable Real-Time Unit (PRU) and Industrial Communication Subsystem.
- (2) The default frequency for AM437x is 200 MHz. However, the max frequency 225 MHz is achievable through display PLL CLKOUT. For DSS limitations when configuring this PLL for frequencies >200 MHz, see the [AM437x Sitara Processors Technical Reference Manual](#).
- (3) AM571x and AM570x PRU-ICSS1 does not pin out the PRU0 core GPIs/GPOs. The other AM571x and AM570x PRU cores (PRU-ICSS1 PRU1, PRU-ICSS2 PRU0, PRU-ICSS2 PRU1) each pin out the number of GPIs/GPOs is listed in [Table 2-1](#).
- (4) AM572x SR1.1 does not have CRC16/32. Within the AM57x family, this feature is only available in AM572x SR2.0, AM571x, and AM570x.
- (5) AM570x PRU-ICSS2 does not pin out these sub-modules. However, they are pinned out on the other AM570x subsystem (PRU-ICSS1).

3 PRU_ICSSG Feature Comparison

Table 3-1 summarizes the PRU_ICSSG features.

Table 3-1. PRU_ICSSG Feature Comparison Across Devices

	Feature	AM65x SR1.0	AM65x SR2.0	AM64x/AM243x
General PRU Specifications	Subsystem type	3x PRU_ICSSG		2x PRU_ICSSG
	Number of PRU cores	2		
	Number of RTU_PRU (Auxiliary PRU) cores	2		
	Number of TX_PRU (Transmit PRU) cores	0	2	
	Max Frequency	250 MHz		333 MHz
	IRAM Size (per PRU / RTU_PRU / TX_PRU core)	12 KB (w/ECC) / 8 KB (w/ ECC) / 0 KB	12 KB (w/ ECC) / 8 KB (w/ ECC) / 6 KB (w/ ECC)	
	DRAM Size (2 DRAMs per PRU_ICSSG)	8 KB (w/ ECC)		
	Shared DRAM Size	64 KB (w/ ECC)		
	INTC	Yes		
	General Purpose Inputs (per PRU core)	Direct; or 16-bit parallel capture; or 28-bit shift; or 3 ch EnDat 2.2; or 9 ch Sigma Delta		
	General Purpose Outputs (per PRU core)	Direct or Shift out		
	GPI Pins (PRU0, PRU1)	PRU_ICSSG0: 20/20		
		PRU_ICSSG1: 20/20		
		PRU_ICSSG2: 18/18 ⁽¹⁾		N/A
	GPO Pins (PRU0, PRU1)	PRU_ICSSG0: 20/20		
		PRU_ICSSG1: 20/20		
PRU_ICSSG2: 18/18 ⁽¹⁾		N/A		
Accelerators: Data Processing	MPY/MAC	Yes		
	CRC 16/32	Yes		
	Scratch Pad	Yes (PRU cores: 4 banks, RTU_PRU cores: 2 banks)	Yes (PRU cores: 3 banks, RTU_PRU cores: 3 banks, TX_PRU cores: 2 banks)	
	IPC Scratch Pad	Yes		
	Broadside RAM	4 KB	2 KB	
	BSWAP	Yes		
	SUM32	Yes		
	Task Manager	Yes		
	Spinlock	Yes		
	Filter Data Base (FDB)	Yes		
Accelerators: Data Movement	XFR2VBUS	Yes		
	PSI TX & RX	Yes		
	XFR2TR	Yes		
Peripherals	UART	1		
	eCAP	1		
	IEP	2		
	MII_G_RT (MII/RGMII)	2		
	MDIO	1		
	SGMII	2 (PRU_ICSSG2 instance only)		No
	PWM	12 primary and 12 complimentary outputs		

(1) PRG2_PRU0/1_GPI/O17 does not have a ball named after it, but it is still muxed out

4 PRUSS Features

Table 4-1 summarizes the PRUSS features.

Table 4-1. PRUSS Features

Feature	AM62x
Subsystem type	1x PRUSS
Number of PRU cores	2
Number of RTU_PRU (Auxiliary PRU) cores	0
Number of TX_PRU (Transmit PRU) cores	0
Max Frequency	333 MHz
IRAM Size (per PRU / RTU_PRU / TX_PRU core)	16 KB (w/ ECC)
DRAM Size (2 DRAMs per PRU_ICSSG)	8 KB (w/ ECC)
Shared DRAM Size	32 KB (w/ ECC)
INTC	Yes
General Purpose Inputs (per PRU core)	Direct; or 16-bit parallel capture; or 28- bit shift;
General Purpose Outputs (per PRU core)	Direct; or Shift out
GPI Pins (PRU0, PRU1)	20, 20
GPO Pins (PRU0, PRU1)	20, 20
Accelerators: Data Processing	
MPY/MAC	Yes
CRC 16/32	Yes
Scratch Pad	Yes (3 banks)
IPC Scratch Pad	No
Broadside RAM	No
BSWAP	No
SUM32	No
Task Manager	No
Spinlock	No
Filter Data Base (FDB)	No
Accelerators: Data Movement	
XFR2VBUS	Yes
PSI TX & RX	No
XFR2TR	No
Peripherals	
UART	1
eCAP	1
IEP	1
MII_G_RT (MII/RGMII)	No
MDIO	No
SGMII	No
PWM	No

5 References

- Texas Instruments: [AM335x and AMIC110 Sitara™ Processors Technical Reference Manual](#)
- Texas Instruments: [AM437x Sitara Processors Technical Reference Manual](#)
- Texas Instruments: [PRU-ICSS/PRU_ICSSG Migration Guide](#)
- Texas Instruments: [AM64x/AM243x Technical Reference Manual](#)
- Texas Instruments: [AM65x/DRA80xM Processors Technical Reference Manual](#)
- Texas Instruments: [AM62x Sitara Processors Technical Reference Manual](#)

6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision F (August 2022) to Revision G (October 2022)	Page
• Updated the numbering format for tables, figures and cross-references throughout the document.....	2
• Added AM263x to PRU-ICSS capable devices.....	2
• Added AM243x to PRU_ICSSG capable devices.....	2
• Changed table view to landscape and added AM263x to table.....	4
• Added AM243x device to table and updated table formatting.....	5

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