## **AArch64 System Instructions**

AT S12E0R: Address Translate Stages 1 and 2 EL0 Read

AT S12E0W: Address Translate Stages 1 and 2 EL0 Write

AT S12E1R: Address Translate Stages 1 and 2 EL1 Read

AT S12E1W: Address Translate Stages 1 and 2 EL1 Write

AT S1E0R: Address Translate Stage 1 EL0 Read

AT S1E0W: Address Translate Stage 1 EL0 Write

AT S1E1R: Address Translate Stage 1 EL1 Read

AT S1E1RP: Address Translate Stage 1 EL1 Read PAN

AT S1E1W: Address Translate Stage 1 EL1 Write

AT S1E1WP: Address Translate Stage 1 EL1 Write PAN

AT S1E2R: Address Translate Stage 1 EL2 Read

AT S1E2W: Address Translate Stage 1 EL2 Write

AT S1E3R: Address Translate Stage 1 EL3 Read

AT S1E3W: Address Translate Stage 1 EL3 Write

**BRB IALL**: Invalidate the Branch Record Buffer

BRB INJ: Branch Record Injection into the Branch Record Buffer

**CFP RCTX**: Control Flow Prediction Restriction by Context

**COSP RCTX**: Clear Other Speculative Restriction by Context

**CPP RCTX**: Cache Prefetch Prediction Restriction by Context

**DC CGDSW**: Clean of Data and Allocation Tags by Set/Way

DC CGDVAC: Clean of Data and Allocation Tags by VA to PoC

DC CGDVADP: Clean of Data and Allocation Tags by VA to PoDP

<u>DC CGDVAP</u>: Clean of Data and Allocation Tags by VA to PoP

DC CGSW: Clean of Allocation Tags by Set/Way

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DC CGVAC: Clean of Allocation Tags by VA to PoC
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**DC CGVADP**: Clean of Allocation Tags by VA to PoDP

DC CGVAP: Clean of Allocation Tags by VA to PoP

<u>DC CIGDPAE</u>: Clean and invalidate of data and allocation tags by PA to PoE

<u>DC CIGDPAPA</u>: Clean and Invalidate of Data and Allocation Tags by PA to PoPA

<u>DC CIGDSW</u>: Clean and Invalidate of Data and Allocation Tags by Set/Way

<u>DC CIGDVAC</u>: Clean and Invalidate of Data and Allocation Tags by VA to PoC

**DC CIGSW**: Clean and Invalidate of Allocation Tags by Set/Way

DC CIGVAC: Clean and Invalidate of Allocation Tags by VA to PoC

DC CIPAE: Data or unified Cache line Clean and Invalidate by PA to PoE

<u>DC CIPAPA</u>: Data or unified Cache line Clean and Invalidate by PA to PoPA

DC CISW: Data or unified Cache line Clean and Invalidate by Set/Way

DC CIVAC: Data or unified Cache line Clean and Invalidate by VA to PoC

DC CSW: Data or unified Cache line Clean by Set/Way

DC CVAC: Data or unified Cache line Clean by VA to PoC

DC CVADP: Data or unified Cache line Clean by VA to PoDP

DC CVAP: Data or unified Cache line Clean by VA to PoP

DC CVAU: Data or unified Cache line Clean by VA to PoU

DC GVA: Data Cache set Allocation Tag by VA

DC GZVA: Data Cache set Allocation Tags and Zero by VA

<u>DC IGDSW</u>: Invalidate of Data and Allocation Tags by Set/Way

**DC IGDVAC**: Invalidate of Data and Allocation Tags by VA to PoC

**DC IGSW**: Invalidate of Allocation Tags by Set/Way

DC IGVAC: Invalidate of Allocation Tags by VA to PoC

DC ISW: Data or unified Cache line Invalidate by Set/Way

DC IVAC: Data or unified Cache line Invalidate by VA to PoC DC ZVA: Data Cache Zero by VA **DVP RCTX:** Data Value Prediction Restriction by Context GCSPOPCX: Guarded Control Stack Pop and Compare exception return record GCSPOPM: Guarded Control Stack Pop GCSPOPX: Guarded Control Stack Pop exception return record **GCSPUSHM:** Guarded Control Stack Push **GCSPUSHX**: Guarded Control Stack Push exception return record GCSSS1: Guarded Control Stack Switch Stack 1 GCSSS2: Guarded Control Stack Switch Stack 2 IC IALLU: Instruction Cache Invalidate All to PoU IC IALLUIS: Instruction Cache Invalidate All to PoU. Inner Shareable IC IVAU: Instruction Cache line Invalidate by VA to PoU SYS S1 <op1> <Cn> <Cm> <op2>, SYSL S1 < op1 > <Cn > <Cm > <op2 > , SYSPS1 < op1> < Cn> < Cm> < op2>: IMPLEMENTATION DEFINED maintenance instructions TLBI ALLE1, TLBI ALLE1NXS: TLB Invalidate All, EL1 TLBI ALLE1IS, TLBI ALLE1ISNXS: TLB Invalidate All, EL1, Inner Shareable TLBI ALLE1OS, TLBI ALLE1OSNXS: TLB Invalidate All, EL1, Outer Shareable TLBI ALLE2, TLBI ALLE2NXS: TLB Invalidate All, EL2 TLBI ALLEZIS, TLBI ALLEZISNXS: TLB Invalidate All, EL2, Inner Shareable TLBI ALLE2OS, TLBI ALLE2OSNXS: TLB Invalidate All, EL2, Outer Shareable TLBI ALLE3, TLBI ALLE3NXS: TLB Invalidate All, EL3 TLBI ALLESIS, TLBI ALLESISNXS: TLB Invalidate All, EL3, Inner Shareable

TLBI ALLE3OS, TLBI ALLE3OSNXS: TLB Invalidate All, EL3, Outer

Shareable

- TLBI ASIDE1, TLBI ASIDE1NXS: TLB Invalidate by ASID, EL1
- TLBI ASIDE1IS, TLBI ASIDE1ISNXS: TLB Invalidate by ASID, EL1, Inner Shareable
- TLBI ASIDE1OS, TLBI ASIDE1OSNXS: TLB Invalidate by ASID, EL1, Outer Shareable
- <u>TLBI IPAS2E1, TLBI IPAS2E1NXS</u>: TLB Invalidate by Intermediate Physical Address, Stage 2, EL1
- TLBI IPAS2E1IS, TLBI IPAS2E1ISNXS: TLB Invalidate by Intermediate Physical Address, Stage 2, EL1, Inner Shareable
- <u>TLBI IPAS2E1OS, TLBI IPAS2E1OSNXS</u>: TLB Invalidate by Intermediate Physical Address, Stage 2, EL1, Outer Shareable
- TLBI IPAS2LE1, TLBI IPAS2LE1NXS: TLB Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1
- TLBI IPAS2LE1IS, TLBI IPAS2LE1ISNXS: TLB Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1, Inner Shareable
- TLBI IPAS2LE1OS, TLBI IPAS2LE1OSNXS: TLB Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1, Outer Shareable
- TLBI PAALL: TLB Invalidate GPT Information by PA, All Entries, Local
- TLBI PAALLOS: TLB Invalidate GPT Information by PA, All Entries, Outer Shareable
- TLBI RIPAS2E1, TLBI RIPAS2E1NXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, EL1
- TLBI RIPAS2E1IS, TLBI RIPAS2E1ISNXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, EL1, Inner Shareable
- <u>TLBI RIPAS2E1OS, TLBI RIPAS2E1OSNXS</u>: TLB Range Invalidate by Intermediate Physical Address, Stage 2, EL1, Outer Shareable
- TLBI RIPAS2LE1, TLBI RIPAS2LE1NXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1
- TLBI RIPAS2LE1IS, TLBI RIPAS2LE1ISNXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1, Inner Shareable
- <u>TLBI RIPAS2LE1OS, TLBI RIPAS2LE1OSNXS</u>: TLB Range Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1, Outer Shareable
- TLBI RPALOS: TLB Range Invalidate GPT Information by PA, Last level, Outer Shareable

TLBI RPAOS: TLB Range Invalidate GPT Information by PA, Outer Shareable

TLBI RVAAE1, TLBI RVAAE1NXS: TLB Range Invalidate by VA, All ASID, EL1

TLBI RVAAE1IS, TLBI RVAAE1ISNXS: TLB Range Invalidate by VA, All ASID, EL1, Inner Shareable

TLBI RVAAE1OS, TLBI RVAAE1OSNXS: TLB Range Invalidate by VA, All ASID, EL1, Outer Shareable

TLBI RVAALE1, TLBI RVAALE1NXS: TLB Range Invalidate by VA, All ASID, Last level, EL1

TLBI RVAALE1IS, TLBI RVAALE1ISNXS: TLB Range Invalidate by VA, All ASID, Last Level, EL1, Inner Shareable

TLBI RVAALE1OS, TLBI RVAALE1OSNXS: TLB Range Invalidate by VA, All ASID, Last Level, EL1, Outer Shareable

TLBI RVAE1, TLBI RVAE1NXS: TLB Range Invalidate by VA, EL1

TLBI RVAE1IS, TLBI RVAE1ISNXS: TLB Range Invalidate by VA, EL1, Inner Shareable

TLBI RVAE1OS, TLBI RVAE1OSNXS: TLB Range Invalidate by VA, EL1, Outer Shareable

TLBI RVAE2, TLBI RVAE2NXS: TLB Range Invalidate by VA, EL2

TLBI RVAE2IS, TLBI RVAE2ISNXS: TLB Range Invalidate by VA, EL2, Inner Shareable

TLBI RVAE2OS, TLBI RVAE2OSNXS: TLB Range Invalidate by VA, EL2, Outer Shareable

TLBI RVAE3, TLBI RVAE3NXS: TLB Range Invalidate by VA, EL3

TLBI RVAE3IS, TLBI RVAE3ISNXS: TLB Range Invalidate by VA, EL3, Inner Shareable

TLBI RVAE3OS, TLBI RVAE3OSNXS: TLB Range Invalidate by VA, EL3, Outer Shareable

TLBI RVALE1, TLBI RVALE1NXS: TLB Range Invalidate by VA, Last level, EL1

TLBI RVALE1IS, TLBI RVALE1ISNXS: TLB Range Invalidate by VA, Last level, EL1, Inner Shareable

TLBI RVALE1OS, TLBI RVALE1OSNXS: TLB Range Invalidate by VA, Last level, EL1, Outer Shareable

TLBI RVALE2, TLBI RVALE2NXS: TLB Range Invalidate by VA, Last level, EL2

TLBI RVALE2IS, TLBI RVALE2ISNXS: TLB Range Invalidate by VA, Last level, EL2, Inner Shareable

TLBI RVALE2OS, TLBI RVALE2OSNXS: TLB Range Invalidate by VA, Last level, EL2, Outer Shareable

TLBI RVALE3, TLBI RVALE3NXS: TLB Range Invalidate by VA, Last level, EL3

TLBI RVALE3IS, TLBI RVALE3ISNXS: TLB Range Invalidate by VA, Last level, EL3, Inner Shareable

TLBI RVALE3OS, TLBI RVALE3OSNXS: TLB Range Invalidate by VA, Last level, EL3, Outer Shareable

TLBI VAAE1, TLBI VAAE1NXS: TLB Invalidate by VA, All ASID, EL1

TLBI VAAE1IS, TLBI VAAE1ISNXS: TLB Invalidate by VA, All ASID, EL1, Inner Shareable

TLBI VAAE1OS, TLBI VAAE1OSNXS: TLB Invalidate by VA, All ASID, EL1, Outer Shareable

TLBI VAALE1, TLBI VAALE1NXS: TLB Invalidate by VA, All ASID, Last level, EL1

TLBI VAALE1IS, TLBI VAALE1ISNXS: TLB Invalidate by VA, All ASID, Last Level, EL1, Inner Shareable

<u>TLBI VAALE1OS, TLBI VAALE1OSNXS</u>: TLB Invalidate by VA, All ASID, Last Level, EL1, Outer Shareable

TLBI VAE1, TLBI VAE1NXS: TLB Invalidate by VA, EL1

TLBI VAE1IS, TLBI VAE1ISNXS: TLB Invalidate by VA, EL1, Inner Shareable

TLBI VAE1OS, TLBI VAE1OSNXS: TLB Invalidate by VA, EL1, Outer Shareable

TLBI VAE2, TLBI VAE2NXS: TLB Invalidate by VA, EL2

TLBI VAE2IS, TLBI VAE2ISNXS: TLB Invalidate by VA, EL2, Inner Shareable

TLBI VAE2OS, TLBI VAE2OSNXS: TLB Invalidate by VA, EL2, Outer Shareable

TLBI VAE3, TLBI VAE3NXS: TLB Invalidate by VA, EL3

TLBI VAE3IS, TLBI VAE3ISNXS: TLB Invalidate by VA, EL3, Inner Shareable

TLBI VAE3OS, TLBI VAE3OSNXS: TLB Invalidate by VA, EL3, Outer Shareable

TLBI VALE1, TLBI VALE1NXS: TLB Invalidate by VA, Last level, EL1

TLBI VALE1IS, TLBI VALE1ISNXS: TLB Invalidate by VA, Last level, EL1, Inner Shareable

TLBI VALE1OS, TLBI VALE1OSNXS: TLB Invalidate by VA, Last level, EL1, Outer Shareable

TLBI VALE2, TLBI VALE2NXS: TLB Invalidate by VA, Last level, EL2

TLBI VALE2IS, TLBI VALE2ISNXS: TLB Invalidate by VA, Last level, EL2, Inner Shareable

<u>TLBI VALE2OS, TLBI VALE2OSNXS</u>: TLB Invalidate by VA, Last level, EL2, Outer Shareable

TLBI VALE3, TLBI VALE3NXS: TLB Invalidate by VA, Last level, EL3

TLBI VALE3IS, TLBI VALE3ISNXS: TLB Invalidate by VA, Last level, EL3, Inner Shareable

TLBI VALE3OS, TLBI VALE3OSNXS: TLB Invalidate by VA, Last level, EL3, Outer Shareable

TLBI VMALLE1, TLBI VMALLE1NXS: TLB Invalidate by VMID, All at stage 1, EL1

<u>TLBI VMALLE1IS, TLBI VMALLE1ISNXS</u>: TLB Invalidate by VMID, All at stage 1, EL1, Inner Shareable

TLBI VMALLE1OS, TLBI VMALLE1OSNXS: TLB Invalidate by VMID, All at stage 1, EL1, Outer Shareable

TLBI VMALLS12E1, TLBI VMALLS12E1NXS: TLB Invalidate by VMID, All at Stage 1 and 2, EL1

TLBI VMALLS12E1IS, TLBI VMALLS12E1ISNXS: TLB Invalidate by VMID, All at Stage 1 and 2, EL1, Inner Shareable

TLBI VMALLS12E1OS, TLBI VMALLS12E1OSNXS: TLB Invalidate by VMID, All at Stage 1 and 2, EL1, Outer Shareable

TLBIP IPAS2E1, TLBIP IPAS2E1NXS: TLB Invalidate Pair by Intermediate Physical Address, Stage 2, EL1

<u>TLBIP IPAS2E1IS, TLBIP IPAS2E1ISNXS</u>: TLB Invalidate Pair by Intermediate Physical Address, Stage 2, EL1, Inner Shareable

TLBIP IPAS2E1OS, TLBIP IPAS2E1OSNXS: TLB Invalidate Pair by Intermediate Physical Address, Stage 2, EL1, Outer Shareable

TLBIP IPAS2LE1, TLBIP IPAS2LE1NXS: TLB Invalidate Pair by Intermediate Physical Address, Stage 2, Last level, EL1

TLBIP IPAS2LE1IS, TLBIP IPAS2LE1ISNXS: TLB Invalidate Pair by Intermediate Physical Address, Stage 2, Last level, EL1, Inner Shareable

<u>TLBIP IPAS2LE1OS, TLBIP IPAS2LE1OSNXS</u>: TLB Invalidate Pair by Intermediate Physical Address, Stage 2, Last level, EL1, Outer Shareable

TLBIP RIPAS2E1, TLBIP RIPAS2E1NXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, EL1

TLBIP RIPAS2E1IS, TLBIP RIPAS2E1ISNXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, EL1, Inner Shareable

<u>TLBIP RIPAS2E1OS, TLBIP RIPAS2E1OSNXS</u>: TLB Range Invalidate by Intermediate Physical Address, Stage 2, EL1, Outer Shareable

TLBIP RIPAS2LE1, TLBIP RIPAS2LE1NXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1

TLBIP RIPAS2LE1IS, TLBIP RIPAS2LE1ISNXS: TLB Range Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1, Inner Shareable

<u>TLBIP RIPAS2LE1OS, TLBIP RIPAS2LE1OSNXS</u>: TLB Range Invalidate by Intermediate Physical Address, Stage 2, Last level, EL1, Outer Shareable

TLBIP RVAAE1, TLBIP RVAAE1NXS: TLB Range Invalidate by VA, All ASID, EL1

TLBIP RVAAE1IS, TLBIP RVAAE1ISNXS: TLB Range Invalidate by VA, All ASID, EL1, Inner Shareable

TLBIP RVAAE1OS, TLBIP RVAAE1OSNXS: TLB Range Invalidate by VA, All ASID, EL1, Outer Shareable

TLBIP RVAALE1, TLBIP RVAALE1NXS: TLB Range Invalidate by VA, All ASID, Last level, EL1

TLBIP RVAALE1IS, TLBIP RVAALE1ISNXS: TLB Range Invalidate by VA, All ASID, Last Level, EL1, Inner Shareable

TLBIP RVAALE1OS, TLBIP RVAALE1OSNXS: TLB Range Invalidate by VA, All ASID, Last Level, EL1, Outer Shareable

TLBIP RVAE1, TLBIP RVAE1NXS: TLB Range Invalidate by VA, EL1

TLBIP RVAE1IS, TLBIP RVAE1ISNXS: TLB Range Invalidate by VA, EL1, Inner Shareable

TLBIP RVAE1OS, TLBIP RVAE1OSNXS: TLB Range Invalidate by VA, EL1, Outer Shareable

TLBIP RVAE2, TLBIP RVAE2NXS: TLB Range Invalidate by VA, EL2

TLBIP RVAE2IS, TLBIP RVAE2ISNXS: TLB Range Invalidate by VA, EL2, Inner Shareable

TLBIP RVAE2OS, TLBIP RVAE2OSNXS: TLB Range Invalidate by VA, EL2, Outer Shareable

TLBIP RVAE3, TLBIP RVAE3NXS: TLB Range Invalidate by VA, EL3

TLBIP RVAE3IS, TLBIP RVAE3ISNXS: TLB Range Invalidate by VA, EL3, Inner Shareable

TLBIP RVAE3OS, TLBIP RVAE3OSNXS: TLB Range Invalidate by VA, EL3, Outer Shareable

TLBIP RVALE1, TLBIP RVALE1NXS: TLB Range Invalidate by VA, Last level, EL1

TLBIP RVALE1IS, TLBIP RVALE1ISNXS: TLB Range Invalidate by VA, Last level, EL1, Inner Shareable

TLBIP RVALE1OS, TLBIP RVALE1OSNXS: TLB Range Invalidate by VA, Last level, EL1, Outer Shareable

TLBIP RVALE2, TLBIP RVALE2NXS: TLB Range Invalidate by VA, Last level, EL2

TLBIP RVALE2IS, TLBIP RVALE2ISNXS: TLB Range Invalidate by VA, Last level, EL2, Inner Shareable

<u>TLBIP RVALE2OS, TLBIP RVALE2OSNXS</u>: TLB Range Invalidate by VA, Last level, EL2, Outer Shareable

TLBIP RVALE3, TLBIP RVALE3NXS: TLB Range Invalidate by VA, Last level, EL3

TLBIP RVALE3IS, TLBIP RVALE3ISNXS: TLB Range Invalidate by VA, Last level, EL3, Inner Shareable

<u>TLBIP RVALE3OS, TLBIP RVALE3OSNXS</u>: TLB Range Invalidate by VA, Last level, EL3, Outer Shareable

TLBIP VAAE1, TLBIP VAAE1NXS: TLB Invalidate Pair by VA, All ASID, EL1

TLBIP VAAE1IS, TLBIP VAAE1ISNXS: TLB Invalidate Pair by VA, All ASID, EL1, Inner Shareable

TLBIP VAAE1OS, TLBIP VAAE1OSNXS: TLB Invalidate Pair by VA, All ASID, EL1, Outer Shareable

TLBIP VAALE1, TLBIP VAALE1NXS: TLB Invalidate Pair by VA, All ASID, Last level, EL1

TLBIP VAALE1IS, TLBIP VAALE1ISNXS: TLB Invalidate Pair by VA, All ASID, Last Level, EL1, Inner Shareable

TLBIP VAALE1OS, TLBIP VAALE1OSNXS: TLB Invalidate Pair by VA, All ASID, Last Level, EL1, Outer Shareable

TLBIP VAE1, TLBIP VAE1NXS: TLB Invalidate Pair by VA, EL1

TLBIP VAE1IS, TLBIP VAE1ISNXS: TLB Invalidate Pair by VA, EL1, Inner Shareable

TLBIP VAE1OS, TLBIP VAE1OSNXS: TLB Invalidate Pair by VA, EL1, Outer Shareable

TLBIP VAE2, TLBIP VAE2NXS: TLB Invalidate Pair by VA, EL2

TLBIP VAE2IS, TLBIP VAE2ISNXS: TLB Invalidate Pair by VA, EL2, Inner Shareable

TLBIP VAE2OS, TLBIP VAE2OSNXS: TLB Invalidate Pair by VA, EL2, Outer Shareable

TLBIP VAE3, TLBIP VAE3NXS: TLB Invalidate Pair by VA, EL3

TLBIP VAE3IS, TLBIP VAE3ISNXS: TLB Invalidate Pair by VA, EL3, Inner Shareable

TLBIP VAE3OS, TLBIP VAE3OSNXS: TLB Invalidate Pair by VA, EL3, Outer Shareable

TLBIP VALE1, TLBIP VALE1NXS: TLB Invalidate Pair by VA, Last level, EL1

TLBIP VALE1IS, TLBIP VALE1ISNXS: TLB Invalidate Pair by VA, Last level, EL1, Inner Shareable

TLBIP VALE1OS, TLBIP VALE1OSNXS: TLB Invalidate Pair by VA, Last level, EL1, Outer Shareable

TLBIP VALE2, TLBIP VALE2NXS: TLB Invalidate Pair by VA, Last level, EL2

TLBIP VALE2IS, TLBIP VALE2ISNXS: TLB Invalidate Pair by VA, Last level, EL2, Inner Shareable

TLBIP VALE2OS, TLBIP VALE2OSNXS: TLB Invalidate Pair by VA, Last level, EL2, Outer Shareable

TLBIP VALE3, TLBIP VALE3NXS: TLB Invalidate Pair by VA, Last level, EL3

TLBIP VALE3IS, TLBIP VALE3ISNXS: TLB Invalidate Pair by VA, Last level, EL3, Inner Shareable

<u>TLBIP VALE3OS, TLBIP VALE3OSNXS</u>: TLB Invalidate Pair by VA, Last level, EL3, Outer Shareable

**TRCIT**: Trace Instrumentation

AArch32AArch64AArch32AArch64Index byExternalRegistersRegistersInstructionsInstructionsEncodingRegisters

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