

31	25	24	20	19	15	14	12	11	7	6	0	
imm[31:12]								rd	opcode			Type-U
imm[20 10:1 11 19:12]								rd	opcode			Type-UJ
imm[11:0]				rs1	funct3			rd	opcode			Type-I
imm[12 10:5]		rs2		rs1	funct3		imm[4:1 11]		opcode			Type-SB
imm[11:5]		rs2		rs1	funct3		imm[4:0]		opcode			Type-S
funct7		rs2		rs1	funct3		rd		opcode			Type-R

RV32I Base Integer Instruction Set

imm[31:12]				rd		0110111		LUI rd, imm
imm[31:12]				rd		0010111		AUIPC rd, imm
imm[20 10:1 11 19:12]				rd		1101111		JAL rd, disp
imm[11:0]			rs1	000	rd		1100111	JALR rd, rs1, imm
imm[12 10:5]		rs2	rs1	000	imm[4:1 11]		1100011	BEQ rs1, rs2, disp
imm[12 10:5]		rs2	rs1	001	imm[4:1 11]		1100011	BNE rs1, rs2, disp
imm[12 10:5]		rs2	rs1	100	imm[4:1 11]		1100011	BLT rs1, rs2, disp
imm[12 10:5]		rs2	rs1	101	imm[4:1 11]		1100011	BGE rs1, rs2, disp
imm[12 10:5]		rs2	rs1	110	imm[4:1 11]		1100011	BLTU rs1, rs2, disp
imm[12 10:5]		rs2	rs1	111	imm[4:1 11]		1100011	BGEU rs1, rs2, disp
imm[11:0]			rs1	000	rd		0000011	LB rd, imm(rs1)
imm[11:0]			rs1	001	rd		0000011	LH rd, imm(rs1)
imm[11:0]			rs1	010	rd		0000011	LW rd, imm(rs1)
imm[11:0]			rs1	100	rd		0000011	LBU rd, imm(rs1)
imm[11:0]			rs1	101	rd		0000011	LHU rd, imm(rs1)
imm[11:5]		rs2	rs1	000	imm[4:0]		0100011	SB rs2, imm(rs1)
imm[11:5]		rs2	rs1	001	imm[4:0]		0100011	SH rs2, imm(rs1)
imm[11:5]		rs2	rs1	010	imm[4:0]		0100011	SW rs2, imm(rs1)
imm[11:0]			rs1	000	rd		0010011	ADDI rd, rs1, imm
imm[11:0]			rs1	010	rd		0010011	SLTI rd, rs1, imm
imm[11:0]			rs1	011	rd		0010011	SLTIU rd, rs1, imm
imm[11:0]			rs1	100	rd		0010011	XORI rd, rs1, imm
imm[11:0]			rs1	110	rd		0010011	ORI rd, rs1, imm
imm[11:0]			rs1	111	rd		0010011	ANDI rd, rs1, imm
000000	0	shamt5	rs1	001	rd		0010011	LLI rd, rs1, imm
000000	0	shamt5	rs1	101	rd		0010011	SRLI rd, rs1, imm
010000	0	shamt5	rs1	101	rd		0010011	SRAI rd, rs1, imm
0000000		rs2	rs1	000	rd		0110011	ADD rd, rs1, rs2
0100000		rs2	rs1	000	rd		0110011	SUB rd, rs1, rs2
0000000		rs2	rs1	001	rd		0110011	SLL rd, rs1, rs2
0000000		rs2	rs1	010	rd		0110011	SLT rd, rs1, rs2
0000000		rs2	rs1	011	rd		0110011	SLTU rd, rs1, rs2
0000000		rs2	rs1	100	rd		0110011	XOR rd, rs1, rs2
0000000		rs2	rs1	101	rd		0110011	SRL rd, rs1, rs2
0100000		rs2	rs1	101	rd		0110011	SRA rd, rs1, rs2
0000000		rs2	rs1	110	rd		0110011	OR rd, rs1, rs2
0000000		rs2	rs1	111	rd		0110011	AND rd, rs1, rs2
0000	pred	pred	succ	00000	000	00000	0001111	FENCE
0000000		00000		00000	001	00000	0001111	FENCE.I

RV64I Base Integer Instruction Set (in addition to RV32I)

imm[11:0]		rs1	110	rd	0000011	LWU rd, imm(rs1)
imm[11:0]		rs1	011	rd	0000011	LD rd, imm(rs1)
imm[11:5]	rs2	rs1	011	imm[4:0]	0100011	SD rs2, imm(rs1)
000000	shamt6	rs1	001	rd	0010011	SLLI rd, rs1, imm
000000	shamt6	rs1	101	rd	0010011	SRLI rd, rs1, imm
010000	shamt6	rs1	101	rd	0010011	SRAI rd, rs1, imm
imm[11:0]		rs1	000	rd	0011011	ADDIW rd, rs1, imm
0000000	shamt5	rs1	001	rd	0011011	SLLIW rd, rs1, imm

31	25	24	20	19	15	14	12	11	7	6	0	
imm[11:0]			rs1		funct3		rd		opcode			Type-I
funct7		rs2		rs1		funct3		rd		opcode		Type-R

RV64I Base Integer Instruction Set (in addition to RV32I) contd

0000000	shamt5	rs1	101	rd	0011011	SRLIW rd, rs1, imm
0100000	shamt5	rs1	101	rd	0011011	SRAIW rd, rs1, imm
0000000	rs2	rs1	000	rd	0111011	ADDW rd, rs1, rs2
0100000	rs2	rs1	000	rd	0111011	SUBW rd, rs1, rs2
0000000	rs2	rs1	001	rd	0111011	SLLW rd, rs1, rs2
0000000	rs2	rs1	101	rd	0111011	SRLW rd, rs1, rs2
0100000	rs2	rs1	101	rd	0111011	SRAW rd, rs1, rs2

RV32M Standard Extension for Integer Multiply and Divide

0000001	rs2	rs1	000	rd	0110011	MUL rd, rs1, rs2
0000001	rs2	rs1	001	rd	0110011	MULH rd, rs1, rs2
0000001	rs2	rs1	010	rd	0110011	MULHSU rd, rs1, rs2
0000001	rs2	rs1	011	rd	0110011	MULHU rd, rs1, rs2
0000001	rs2	rs1	100	rd	0110011	DIV rd, rs1, rs2
0000001	rs2	rs1	101	rd	0110011	DIVU rd, rs1, rs2
0000001	rs2	rs1	110	rd	0110011	REM rd, rs1, rs2
0000001	rs2	rs1	111	rd	0110011	REMU rd, rs1, rs2

RV64M Standard Extension for Integer Multiply and Divide (in addition to RV32M)

0000001	rs2	rs1	000	rd	0111011	MULW rd, rs1, rs2
0000001	rs2	rs1	100	rd	0111011	DIVW rd, rs1, rs2
0000001	rs2	rs1	101	rd	0111011	DIVUW rd, rs1, rs2
0000001	rs2	rs1	110	rd	0111011	REMW rd, rs1, rs2
0000001	rs2	rs1	111	rd	0111011	REMUW rd, rs1, rs2

RV32A Standard Extension for Atomic Instructions

00010	aqrl	00000	rs1	010	rd	0101111	LR.W rd, (rs1)
00011	aqrl	rs2	rs1	010	rd	0101111	SC.W rd, rs2, (rs1)
00001	aqrl	rs2	rs1	010	rd	0101111	AMOSWAP.W rd, rs2, (rs1)
00000	aqrl	rs2	rs1	010	rd	0101111	AMOADD.W rd, rs2, (rs1)
00100	aqrl	rs2	rs1	010	rd	0101111	AMOXOR.W rd, rs2, (rs1)
01000	aqrl	rs2	rs1	010	rd	0101111	AMOOR.W rd, rs2, (rs1)
01100	aqrl	rs2	rs1	010	rd	0101111	AMOAND.W rd, rs2, (rs1)
10000	aqrl	rs2	rs1	010	rd	0101111	AMOMIN.W rd, rs2, (rs1)
10100	aqrl	rs2	rs1	010	rd	0101111	AMOMAX.W rd, rs2, (rs1)
11000	aqrl	rs2	rs1	010	rd	0101111	AMOMINU.W rd, rs2, (rs1)
11100	aqrl	rs2	rs1	010	rd	0101111	AMOMAXU.W rd, rs2, (rs1)

RV64A Standard Extension for Atomic Instructions (in addition to RV32A)

00010	aqrl	00000	rs1	011	rd	0101111	LR.D rd, (rs1)
00011	aqrl	rs2	rs1	011	rd	0101111	SC.D rd, rs2, (rs1)
00001	aqrl	rs2	rs1	011	rd	0101111	AMOSWAP.D rd, rs2, (rs1)
00000	aqrl	rs2	rs1	011	rd	0101111	AMOADD.D rd, rs2, (rs1)
00100	aqrl	rs2	rs1	011	rd	0101111	AMOXOR.D rd, rs2, (rs1)
01000	aqrl	rs2	rs1	011	rd	0101111	AMOOR.D rd, rs2, (rs1)
01100	aqrl	rs2	rs1	011	rd	0101111	AMOAND.D rd, rs2, (rs1)
10000	aqrl	rs2	rs1	011	rd	0101111	AMOMIN.D rd, rs2, (rs1)
10100	aqrl	rs2	rs1	011	rd	0101111	AMOMAX.D rd, rs2, (rs1)
11000	aqrl	rs2	rs1	011	rd	0101111	AMOMINU.D rd, rs2, (rs1)
11100	aqrl	rs2	rs1	011	rd	0101111	AMOMAXU.D rd, rs2, (rs1)

31	25	24	20	19	15	14	12	11	7	6	0
imm[11:0]				rs1	funct3	rd	opcode				
imm[11:5]			rs2	rs1	funct3	imm[4:0]	opcode				
rs3	funct2		rs2	rs1	funct3	rd	opcode				
funct7			rs2	rs1	funct3	rd	opcode				

Type-I
Type-S
Type-R4
Type-R

RV32S Standard Extension for Supervisor-level Instructions

0000000	00000	00000	000	00000	1110011
0000000	00001	00000	000	00000	1110011
0001000	00000	00000	000	00000	1110011
0001000	00001	rs1	000	00000	1110011
0001000	00010	00000	000	00000	1110011
0011000	00110	00000	000	00000	1110011
0011000	00101	00000	000	00000	1110011
0010000	00101	00000	000	00000	1110011
110000000000		00000	010	rd	1110011
110000000001		00000	010	rd	1110011
110000000010		00000	010	rd	1110011
110010000000		00000	010	rd	1110011
110010000001		00000	010	rd	1110011
110010000010		00000	010	rd	1110011
imm[11:0]		rs1	001	rd	1110011
imm[11:0]		rs1	010	rd	1110011
imm[11:0]		rs1	011	rd	1110011
imm[11:0]		imm5	101	rd	1110011
imm[11:0]		imm5	110	rd	1110011
imm[11:0]		imm5	111	rd	1110011

SCALL
SBREAK
SRET
SFENCE.VM
WFI
MRTH
MRTS
HRTS
RDCYCLE rd, csr, rs1
RDTIME rd, csr, rs1
RDINSTRET rd, csr, rs1
RDCYCLEH rd, csr, rs1
RDTIMEH rd, csr, rs1
RDINSTRETH rd, csr, rs1
CSRRW rd, csr, rs1
CSRRS rd, csr, rs1
CSRRC rd, csr, rs1
CSRRWI rd, csr, irs1
CSRRSI rd, csr, irs1
CSRRCI rd, csr, irs1

RV32F Standard Extension for Single-Precision Floating-Point

imm[11:0]			rs1	010	rd	0000111
imm[11:5]			rs2	rs1	imm[4:0]	0100111
rs3	00	rs2	rs1	rm	rd	1000011
rs3	00	rs2	rs1	rm	rd	1000111
rs3	00	rs2	rs1	rm	rd	1001011
rs3	00	rs2	rs1	rm	rd	1001111
0000000		rs2	rs1	rm	rd	1010011
0000100		rs2	rs1	rm	rd	1010011
0001000		rs2	rs1	rm	rd	1010011
0001100		rs2	rs1	rm	rd	1010011
0010000		rs2	rs1	000	rd	1010011
0010000		rs2	rs1	001	rd	1010011
0010000		rs2	rs1	010	rd	1010011
0010100		rs2	rs1	000	rd	1010011
0010100		rs2	rs1	001	rd	1010011
0101100		00000	rs1	rm	rd	1010011
1010000		rs2	rs1	000	rd	1010011
1010000		rs2	rs1	001	rd	1010011
1010000		rs2	rs1	010	rd	1010011
1100000		00000	rs1	rm	rd	1010011
1100000		00001	rs1	rm	rd	1010011
1101000		00000	rs1	rm	rd	1010011
1101000		00001	rs1	rm	rd	1010011
1110000		00000	rs1	000	rd	1010011
1110000		00000	rs1	001	rd	1010011
1111000		00000	rs1	000	rd	1010011

FLW frd, imm(rs1)
FSW frs2, imm(rs1)
FMADD.S frd, frs1, frs2, frs3
FMSUB.S frd, frs1, frs2, frs3
FNMSUB.S frd, frs1, frs2, frs3
FNMADD.S frd, frs1, frs2, frs3
FADD.S frd, frs1, frs2
FSUB.S frd, frs1, frs2
FMUL.S frd, frs1, frs2
FDIV.S frd, frs1, frs2
FSGNJ.S frd, frs1, frs2
FSGNJN.S frd, frs1, frs2
FSGNJX.S frd, frs1, frs2
FMIN.S frd, frs1, frs2
FMAX.S frd, frs1, frs2
FSQRT.S frd, frs1, frs2
FLE.S frd, rs1, frs2
FLT.S frd, rs1, frs2
FEQ.S frd, rs1, frs2
FCVT.W.S rd, frs1
FCVT.WU.S rd, frs1
FCVT.S.W frd, rs1
FCVT.S.WU frd, rs1
FMV.X.S rd, frs1
FCLASS.S rd, frs1
FMV.S.X frd, rs1

31	25	24	20	19	15	14	12	11	7	6	0	
imm[11:0]				rs1	funct3		rd		opcode			Type-I
funct7			rs2	rs1	funct3		rd		opcode			Type-R
imm[11:5]			rs2	rs1	funct3		imm[4:0]		opcode			Type-S
rs3	funct2		rs2	rs1	funct3		rd		opcode			Type-R4

RV32F Standard Extension for Single-Precision Floating-Point contd

000000000011	00000	010	rd	1110011	FRCSR rd, csr, rs1
000000000010	00000	010	rd	1110011	FRRM rd, csr, rs1
000000000001	00000	010	rd	1110011	FRFLAGS rd, csr, rs1
000000000011	rs1	001	rd	1110011	FSCSR rd, csr, rs1
000000000010	rs1	001	rd	1110011	FSRM rd, csr, rs1
000000000001	rs1	001	rd	1110011	FSFLAGS rd, csr, rs1
000000000010	imm5	101	rd	1110011	FSRMI rd, csr, irs1
000000000001	imm5	101	rd	1110011	FSFLAGSI rd, csr, irs1

RV64F Standard Extension for Single-Precision Floating-Point (in addition to RV32F)

1100000	00010	rs1	rm	rd	1010011	FCVT.L.S rd, frs1
1100000	00011	rs1	rm	rd	1010011	FCVT.LU.S rd, frs1
1101000	00010	rs1	rm	rd	1010011	FCVT.S.L frd, rs1
1101000	00011	rs1	rm	rd	1010011	FCVT.S.LU frd, rs1

RV32D Standard Extension for Double-Precision Floating-Point

imm[11:0]			rs1	011	rd	0000111	FLD frd, imm(rs1)
imm[11:5]		rs2	rs1	011	imm[4:0]	0100111	FSD frs2, imm(rs1)
rs3	01	rs2	rs1	rm	rd	1000011	FMADD.D frd, frs1, frs2, frs3
rs3	01	rs2	rs1	rm	rd	1000111	FMSUB.D frd, frs1, frs2, frs3
rs3	01	rs2	rs1	rm	rd	1001011	FNMSUB.D frd, frs1, frs2, frs3
rs3	01	rs2	rs1	rm	rd	1001111	FNMADD.D frd, frs1, frs2, frs3
0000001		rs2	rs1	rm	rd	1010011	FADD.D frd, frs1, frs2
0000101		rs2	rs1	rm	rd	1010011	FSUB.D frd, frs1, frs2
0001001		rs2	rs1	rm	rd	1010011	FMUL.D frd, frs1, frs2
0001101		rs2	rs1	rm	rd	1010011	FDIV.D frd, frs1, frs2
0010001		rs2	rs1	000	rd	1010011	FSGNJ.D frd, frs1, frs2
0010001		rs2	rs1	001	rd	1010011	FSGNJN.D frd, frs1, frs2
0010001		rs2	rs1	010	rd	1010011	FSGNJX.D frd, frs1, frs2
0010101		rs2	rs1	000	rd	1010011	FMIN.D frd, frs1, frs2
0010101		rs2	rs1	001	rd	1010011	FMAX.D frd, frs1, frs2
0100000		00001	rs1	rm	rd	1010011	FCVT.S.D frd, frs1
0100001		00000	rs1	rm	rd	1010011	FCVT.D.S frd, frs1
0101101		00000	rs1	rm	rd	1010011	FSQRT.D frd, frs1
1010001		rs2	rs1	000	rd	1010011	FLE.D frd, rs1, frs2
1010001		rs2	rs1	001	rd	1010011	FLT.D frd, rs1, frs2
1010001		rs2	rs1	010	rd	1010011	FEQ.D frd, rs1, frs2
1100001		00000	rs1	rm	rd	1010011	FCVT.W.D rd, frs1
1100001		00001	rs1	rm	rd	1010011	FCVT.WU.D rd, frs1
1101001		00000	rs1	rm	rd	1010011	FCVT.D.W frd, rs1
1101001		00001	rs1	rm	rd	1010011	FCVT.D.WU frd, rs1
1110001		00000	rs1	001	rd	1010011	FCLASS.D rd, frs1

RV64D Standard Extension for Double-Precision Floating-Point (in addition to RV32D)

1100001	00010	rs1	rm	rd	1010011	FCVT.L.D rd, frs1
1100001	00011	rs1	rm	rd	1010011	FCVT.LU.D rd, frs1
1110001	00000	rs1	000	rd	1010011	FMV.X.D rd, frs1
1101001	00010	rs1	rm	rd	1010011	FCVT.D.L frd, rs1
1101001	00011	rs1	rm	rd	1010011	FCVT.D.LU frd, rs1
1111001	00000	rs1	000	rd	1010011	FMV.D.X frd, rs1

15	13	12	10	9	7	6	5	4	2	1	0		
funct3		imm8							rd'		op	Type-CIW	
funct3		imm3			rs1'		imm2		rd'		op	Type-CL	
funct3		imm3			rs1'		imm2		rs2'		op	Type-CS	
funct3		imm1	rd/rs1				imm5			op		Type-CI	
funct3		imm11									op		Type-CJ
funct3		imm3			rs1'		imm5			op		Type-CB	
funct4			rd/rs1				rs2			op		Type-CR	
funct3		imm6					rs2			op		Type-CSS	

RV32C Standard Extension for Compressed Instructions

000		imm[5:4 9:6 2 3]				rd'	00	C.ADDI4SPN rd, rs1, imm
001		imm[5:3]		rs1'		imm[7:6]	rd'	C.FLD frd, imm(rs1)
010		imm[5:3]		rs1'		imm[2:6]	rd'	C.LW rd, imm(rs1)
011		imm[5:3]		rs1'		imm[2:6]	rd'	C.FLW frd, imm(rs1)
101		imm[5:3]		rs1'		imm[7:6]	rs2'	C.FSD frs2, imm(rs1)
110		imm[5:3]		rs1'		imm[2:6]	rs2'	C.SW rs2, imm(rs1)
111		imm[5:3]		rs1'		imm[2:6]	rs2'	C.FSW frs2, imm(rs1)
000	0		00000			00000	01	C.NOP
000	imm[5]		rs1/rd			imm[4:0]	01	C.ADDI rd, rs1, imm
001			imm[11 4 9:8 10 6 7 3:1 5]				01	C.JAL rd, disp
010	imm[5]		rs1/rd			imm[4:0]	01	C.LI rd, rs1, imm
011	imm[17]		rd			imm[16:12]	01	C.LUI rd, imm
011	imm[9]		rs1/rd			imm[4 6 8:7 5]	01	C.ADDI16SP rd, rs1, imm
100	imm[5]	00		rs1'/rd'		imm[4:0]	01	C.SRLI rd, rs1, imm
100	imm[5]	01		rs1'/rd'		imm[4:0]	01	C.SRAI rd, rs1, imm
100	imm[5]	10		rs1'/rd'		imm[4:0]	01	C.ANDI rs1, rs2, disp
100		011		rs1'/rd'	00	rs2'	01	C.SUB rd, rs1, rs2
100		011		rs1'/rd'	01	rs2'	01	C.XOR rd, rs1, rs2
100		011		rs1'/rd'	10	rs2'	01	C.OR rd, rs1, rs2
100		011		rs1'/rd'	11	rs2'	01	C.AND rd, rs1, rs2
100		111		rs1'/rd'	00	rs2'	01	C.SUBW rd, rs1, rs2
100		111		rs1'/rd'	01	rs2'	01	C.ADDW rd, rs1, rs2
101			imm[11 4 9:8 10 6 7 3:1 5]				01	C.J rd, disp
110		imm[8 4:3]		rs1'		imm[7:6 2:1 5]	01	C.BEQZ rs1, rs2, disp
111		imm[8 4:3]		rs1'		imm[7:6 2:1 5]	01	C.BNEZ rs1, rs2, disp
000	imm[5]		rd			imm[4:0]	10	C.SLLI rd, rs1, imm
001	imm[5]		rd			imm[4:3 8:6]	10	C.FLDSP frd, imm(rs1)
010	imm[5]		rd			imm[4:2 7:6]	10	C.LWSP rd, imm(rs1)
011	imm[5]		rd			imm[4:2 7:6]	10	C.FLWSP frd, imm(rs1)
1000			rs1			00000	10	C.JR rd, rs1, imm
1000			rd			rs2	10	C.MV rd, rs1, rs2
100		100		000	00	000	10	C.EBREAK
1001			rs1			00000	10	C.JALR rd, rs1, imm
1001			rd			rs2	10	C.ADD rd, rs1, rs2
101			imm[5:3 8:6]			rs2	10	C.FSDSP frs2, imm(rs1)
110			imm[5:2 7:6]			rs2	10	C.SWSP rs2, imm(rs1)
111			imm[5:2 7:6]			rs2	10	C.FSWSP frs2, imm(rs1)

RV64C Standard Extension for Compressed Instructions (in addition to RV32C)

011		imm[5:3]		rs1'	imm[7:6]	rd'	00	C.LD rd, imm(rs1)
111		imm[5:3]		rs1'	imm[7:6]	rs2'	00	C.SD rs2, imm(rs1)
001	imm[5]		rs1/rd			imm[4:0]	01	C.ADDIW rd, rs1, imm
011	imm[5]		rs1/rd			imm[4:3 8:6]	10	C.LDSP rd, imm(rs1)
111			imm[5:3 8:6]			rs2	10	C.SDSP rs2, imm(rs1)