GBZ80(7) Miscellaneous Information Manual GBZ80(7)

NAME

gbz80 — CPU opcode reference

DESCRIPTION

This is the list of opcodes supported by <u>rgbasm(1)</u>, including a short description, the number of bytes needed to encode them and the number of CPU cycles at 1MHz (or 2MHz in GBC dual speed mode) needed to complete them.

Note: All arithmetic/logic operations that use register **A** as destination can omit the destination as it is assumed to be register **A** by default. The following two lines have the same effect:

```
OR A,B
```

LEGEND

List of abbreviations used in this document.

```
r8 Any of the 8-bit registers (A, B, C, D, E, H, L).
```

r16 Any of the general-purpose 16-bit registers (**BC**, **DE**, **HL**).

n8 8-bit integer constant.

n16

16-bit integer constant.

e8 8-bit offset (-128 to 127).

u3 3-bit unsigned integer constant (0 to 7).

cc Condition codes:

Z Execute if Z is set.

NZ Execute if Z is not set.

C Execute if C is set.

NC Execute if C is not set.

vec

One of the RST vectors (0x00, 0x08, 0x10, 0x18, 0x20, 0x28, 0x30 and 0x38).

INSTRUCTION OVERVIEW

8-bit Arithmetic and Logic Instructions

ADC A,r8

ADC A,[HL]

ADC A,n8

ADD A,r8

ADD A,[HL]

ADD A,n8

AND A,r8

AND A,[HL]

AND A,n8

CP A,r8

CP A,[HL]

<u>CP A,n8</u>

DEC r8

DEC [HL]

INC r8

INC [HL]

OR A,r8

OR A,[HL]

OR A,n8

SBC A,r8

SBC A,[HL]

SBC A,n8

SUB A,r8

SUB A,[HL]

SUB A,n8

XOR A,r8

XOR A,[HL]

XOR A,n8

16-bit Arithmetic Instructions

ADD HL,r16

DEC r16

INC r16

Bit Operations Instructions

BIT u3,r8

BIT u3,[HL]

RES u3,r8

RES u3,[HL]

SET u3,r8

SET u3,[HL]

SWAP r8

SWAP [HL]

Bit Shift Instructions

RL r8

RL[HL]

RLA

RLC r8

RLC [HL]

RLCA

RR r8

RR [HL]

RRA

RRC r8

RRC [HL]

RRCA

SLA r8

SLA [HL]

SRA_{r8}

SRA [HL]

SRL_{r8}

SRL [HL]

Load Instructions

LD r8,r8

LD r8,n8

LD r16,n16

LD [HL],r8

LD [HL],n8

LD r8,[HL]

LD [r16],A

LD [n16],A

<u>LDH [n16],A</u>

LDH [C],A

LD A,[r16]

LD A,[n16]

LDH A,[n16]

LDH A,[C]

LD [HLI],A

LD [HLD],A

LD A,[HLI]

LD A,[HLD]

Jumps and Subroutines

CALL n16

CALL cc,n16

JP HL

JP n16

JP cc,n16

JR e8

JR cc,e8

RET cc

RET

RETI

RST vec

Stack Operations Instructions

ADD HL,SP

ADD SP,e8

DEC SP

INC SP

LD SP,n16

LD [n16],SP

LD HL,SP+e8

LD SP,HL

POP AF

POP r16

PUSH AF

PUSH r16

Miscellaneous Instructions

CCF

CPL

DAA

<u>DI</u>

<u>EI</u>

HALT

NOP

SCF

STOP

INSTRUCTION REFERENCE

ADC A,r8

Add the value in r8 plus the carry flag to A.

Cycles: 1

Bytes: 1

Flags:

Z

Set if result is 0.

Ν

0

Н

Set if overflow from bit 3.

C

Set if overflow from bit 7.

ADC A,[HL]

Add the byte pointed to by **HL** plus the carry flag to **A**.

Cycles: 2

Bytes: 1

Flags: See ADC A,r8

ADC A,n8

Add the value n8 plus the carry flag to A.

Cycles: 2

Bytes: 2

Flags: See ADC A,r8

ADD A,r8

Add the value in r8 to A.

Cycles: 1

Bytes: 1

Flags:

Z

Set if result is 0.

Ν

0

Н

Set if overflow from bit 3.

C

Set if overflow from bit 7.

ADD A,[HL]

Add the byte pointed to by **HL** to **A**.

Cycles: 2 Bytes: 1

Flags: See ADD A,r8

ADD A,n8

Add the value *n8* to **A**.

Cycles: 2 Bytes: 2

Flags: See ADD A,r8

ADD HL,r16

Add the value in *r16* to **HL**.

Cycles: 2

Bytes: 1

Flags:

Ν

0

Н

Set if overflow from bit 11.

С

Set if overflow from bit 15.

ADD HL,SP

Add the value in SP to HL.

Cycles: 2

Bytes: 1

Flags: See ADD HL,r16

ADD SP,e8

Add the signed value e8 to SP.

Cycles: 4

Bytes: 2

Flags:

Z

0

Ν

0

Н

Set if overflow from bit 3.

C

Set if overflow from bit 7.

AND A,r8

Bitwise AND between the value in r8 and A.

```
Bytes: 1
Flags:

Z
Set if result is 0.

N
0
H
1
C
```

AND A,[HL]

0

Bitwise AND between the byte pointed to by **HL** and **A**.

Cycles: 2 Bytes: 1

Flags: See AND A,r8

AND A,n8

Bitwise AND between the value in n8 and A.

Cycles: 2 Bytes: 2

Flags: See AND A,r8

BIT u3,r8

Test bit *u3* in register *r8*, set the zero flag if bit not set.

Cycles: 2 Bytes: 2 Flags:

Z

Set if the selected bit is 0.

N 0 H 1

BIT u3,[HL]

Test bit u3 in the byte pointed by **HL**, set the zero flag if bit not set.

Cycles: 3 Bytes: 2

Flags: See BIT u3,r8

CALL n16

Call address n16. This pushes the address of the instruction after the **CALL** on the stack, such that <u>RET</u> can pop it later; then, it executes an implicit <u>JP n16</u>.

Bytes: 3

Flags: None affected.

CALL cc,n16

Call address *n16* if condition *cc* is met.

Cycles: 6 taken / 3 untaken

Bytes: 3

Flags: None affected.

CCF

Complement Carry Flag.

Cycles: 1

Bytes: 1

Flags:

Ν

0

Н

0

C

Inverted.

CP A,r8

Subtract the value in r8 from **A** and set flags accordingly, but don't store the result. This is useful for ComParing values.

Cycles: 1

Bytes: 1

Flags:

Z

Set if result is 0.

N

1

Н

Set if borrow from bit 4.

С

Set if borrow (i.e. if r8 > A).

CP A,[HL]

Subtract the byte pointed to by **HL** from **A** and set flags accordingly, but don't store the result.

Cycles: 2

Bytes: 1

Flags: See CP A,r8

CP A,n8

Subtract the value *n8* from **A** and set flags accordingly, but don't store the result.

Bytes: 2

Flags: See CP A,r8

CPL

ComPLement accumulator $(A = \sim A)$.

Cycles: 1

Bytes: 1

Flags:

Ν

1

1

Н

DAA

Decimal Adjust Accumulator to get a correct BCD representation after an arithmetic instruction.

Cycles: 1

Bytes: 1

Flags:

Z

Set if result is 0.

Н

0

С

Set or reset depending on the operation.

DEC r8

Decrement value in register r8 by 1.

Cycles: 1

Bytes: 1

Flags:

Z

Set if result is 0.

Ν

Н

Set if borrow from bit 4.

DEC [HL]

Decrement the byte pointed to by **HL** by 1.

Cycles: 3

Bytes: 1

Flags: See DEC r8

DEC r16

Decrement value in register r16 by 1.

Cycles: 2 Bytes: 1

Flags: None affected.

DEC SP

Decrement value in register SP by 1.

Cycles: 2 Bytes: 1

Flags: None affected.

DI

Disable Interrupts by clearing the IME flag.

Cycles: 1
Bytes: 1

Flags: None affected.

ΕI

Enable Interrupts by setting the IME flag. The flag is only set after the instruction following EI.

Cycles: 1 Bytes: 1

Flags: None affected.

HALT

Enter CPU low-power consumption mode until an interrupt occurs. The exact behavior of this instruction depends on the state of the **IME** flag.

IME set

The CPU enters low-power mode until *after* an interrupt is about to be serviced. The handler is executed normally, and the CPU resumes execution after the **HALT** when that returns.

IME not set

The behavior depends on whether an interrupt is pending (i.e. '[IE] & [IF]' is non-zero).

None pending

As soon as an interrupt becomes pending, the CPU resumes execution. This is like the above, except that the handler is *not* called.

Some pending

The CPU continues execution after the **HALT**, but the byte after it is read twice in a row (**PC** is not incremented, due to a hardware bug).

Cycles: -

Bytes: 1

Flags: None affected.

INC r8

Increment value in register r8 by 1.

Bytes: 1

Flags:

Set if result is 0.

Ν

0

Н

Set if overflow from bit 3.

INC [HL]

Increment the byte pointed to by **HL** by 1.

Cycles: 3 Bytes: 1

Flags: See INC r8

INC r16

Increment value in register r16 by 1.

Cycles: 2 Bytes: 1

Flags: None affected.

INC SP

Increment value in register SP by 1.

Cycles: 2 Bytes: 1

Flags: None affected.

JP n16

Jump to address n16; effectively, store n16 into **PC**.

Cycles: 4 Bytes: 3

Flags: None affected.

JP cc,n16

Jump to address n16 if condition cc is met.

Cycles: 4 taken / 3 untaken

Bytes: 3

Flags: None affected.

JP HL

Jump to address in HL; effectively, load PC with value in register HL.

Cycles: 1

Bytes: 1

Flags: None affected.

JR e8

Relative Jump by adding *e8* to the address of the instruction following the **JR**. To clarify, an operand of 0 is equivalent to no jumping.

Cycles: 3 Bytes: 2

Flags: None affected.

JR cc,e8

Relative Jump by adding *e8* to the current address if condition *cc* is met.

Cycles: 3 taken / 2 untaken

Bytes: 2

Flags: None affected.

LD r8,r8

Load (copy) value in register on the right into register on the left.

Cycles: 1 Bytes: 1

Flags: None affected.

LD r8,n8

Load value n8 into register r8.

Cycles: 2 Bytes: 2

Flags: None affected.

LD r16,n16

Load value *n16* into register *r16*.

Cycles: 3 Bytes: 3

Flags: None affected.

LD [HL],r8

Store value in register *r8* into byte pointed to by register **HL**.

Cycles: 2 Bytes: 1

Flags: None affected.

LD [HL],n8

Store value *n8* into byte pointed to by register **HL**.

Cycles: 3

Bytes: 2

Flags: None affected.

LD r8,[HL]

Load value into register r8 from byte pointed to by register HL.

Cycles: 2

Bytes: 1

Flags: None affected.

LD [r16],A

Store value in register **A** into byte pointed to by register *r16*.

Cycles: 2

Bytes: 1

Flags: None affected.

LD [n16],A

Store value in register **A** into byte at address n16.

Cycles: 4

Bytes: 3

Flags: None affected.

LDH [n16],A

Store value in register **A** into byte at address n16, provided it is between \$FF00 and \$FFFF.

Cycles: 3

Bytes: 2

Flags: None affected.

This is sometimes written as 'ldio [n16], a', or 'ld [\$ff00+n8], a'.

LDH [C],A

Store value in register **A** into byte at address \$FF00+C.

Cycles: 2

Bytes: 1

Flags: None affected.

This is sometimes written as 'ldio [c], a', or 'ld [\$ff00+c], a'.

LD A,[r16]

Load value in register **A** from byte pointed to by register *r16*.

Cycles: 2

Bytes: 1

Flags: None affected.

LD A,[n16]

Load value in register **A** from byte at address *n16*.

Cycles: 4 Bytes: 3

Flags: None affected.

LDH A,[n16]

Load value in register **A** from byte at address *n16*, provided it is between *\$FF00* and *\$FFFF*.

Cycles: 3 Bytes: 2

Flags: None affected.

This is sometimes written as 'ldio a, [n16]', or 'ld a, [\$ff00+n8]'.

LDH A,[C]

Load value in register **A** from byte at address \$FF00+c.

Cycles: 2 Bytes: 1

Flags: None affected.

This is sometimes written as 'ldio a, [c]', or 'ld a, [\$ff00+c]'.

LD [HLI],A

Store value in register **A** into byte pointed by **HL** and increment **HL** afterwards.

Cycles: 2 Bytes: 1

Flags: None affected.

LD [HLD],A

Store value in register **A** into byte pointed by **HL** and decrement **HL** afterwards.

Cycles: 2

Bytes: 1

Flags: None affected.

LD A,[HLD]

Load value into register **A** from byte pointed by **HL** and decrement **HL** afterwards.

Cycles: 2 Bytes: 1

Flags: None affected.

LD A,[HLI]

Load value into register A from byte pointed by HL and increment HL afterwards.

Cycles: 2

Bytes: 1

Flags: None affected.

LD SP,n16

Load value *n16* into register **SP**.

Cycles: 3 Bytes: 3

Flags: None affected.

LD [n16],SP

Store **SP & \$FF** at address n16 and **SP** >> **8** at address n16 + 1.

Cycles: 5 Bytes: 3

Flags: None affected.

LD HL,SP+e8

Add the signed value e8 to SP and store the result in HL.

Cycles: 3

Bytes: 2

Flags:

Z

0

N

0

Н

Set if overflow from bit 3.

C

Set if overflow from bit 7.

LD SP,HL

Load register HL into register SP.

Cycles: 2

Bytes: 1

Flags: None affected.

NOP

No OPeration.

Cycles: 1

Bytes: 1

Flags: None affected.

OR A,r8

Store into A the bitwise OR of the value in r8 and A.

Cycles: 1

Bytes: 1

Flags:

```
Z Set if result is 0.

N 0

H 0

C 0
```

OR A,[HL]

Store into A the bitwise OR of the byte pointed to by HL and A.

Cycles: 2 Bytes: 1

Flags: See OR A,r8

OR A,n8

Store into **A** the bitwise OR of *n8* and **A**.

Cycles: 2 Bytes: 2

Flags: See OR A,r8

POP AF

Pop register **AF** from the stack. This is roughly equivalent to the following *imaginary* instructions:

```
inc sp
ld a, [sp]
inc sp
ld f, [sp]; See below for individual flags
```

Cycles: 3

Bytes: 1

Flags:

Z

Set from bit 7 of the popped low byte.

Ν

Set from bit 6 of the popped low byte.

Н

Set from bit 5 of the popped low byte.

C

Set from bit 4 of the popped low byte.

POP r16

Pop register *r16* from the stack. This is roughly equivalent to the following *imaginary* instructions:

```
ld LOW(r16), [sp] ; C, E or L
inc sp
ld HIGH(r16), [sp] ; B, D or H
inc sp
```

Cycles: 3

Bytes: 1

Flags: None affected.

PUSH AF

Push register **AF** into the stack. This is roughly equivalent to the following *imaginary* instructions:

```
dec sp
ld [sp], a
dec sp
ld [sp], flag_Z << 7 | flag_N << 6 | flag_H << 5 | flag_C << 4</pre>
```

Cycles: 4

Bytes: 1

Flags: None affected.

PUSH r16

Push register *r16* into the stack. This is roughly equivalent to the following *imaginary* instructions:

```
dec sp
ld [sp], HIGH(r16); B, D or H
dec sp
ld [sp], LOW(r16); C, E or L
```

Cycles: 4

Bytes: 1

Flags: None affected.

RES u3,r8

Set bit *u3* in register *r8* to 0. Bit 0 is the rightmost one, bit 7 the leftmost one.

Cycles: 2

Bytes: 2

Flags: None affected.

RES u3,[HL]

Set bit *u3* in the byte pointed by **HL** to 0. Bit 0 is the rightmost one, bit 7 the leftmost one.

Cycles: 4

Bytes: 2

Flags: None affected.

RET

Return from subroutine. This is basically a **POP PC** (if such an instruction existed). See <u>POP r16</u> for an explanation of how **POP** works.

Cycles: 4

Bytes: 1

Flags: None affected.

RET cc

Return from subroutine if condition cc is met.

Cycles: 5 taken / 2 untaken

Bytes: 1

Flags: None affected.

RETI

Return from subroutine and enable interrupts. This is basically equivalent to executing <u>EI</u> then <u>RET</u>, meaning that **IME** is set right after this instruction.

Cycles: 4

Bytes: 1

Flags: None affected.

RL r8

Rotate bits in register r8 left through carry.

Cycles: 2

Bytes: 2

Flags:

Z

Set if result is 0.

Ν

0

Н

0

С

Set according to result.

RL [HL]

Rotate byte pointed to by **HL** left through carry.

Cycles: 4

Bytes: 2

•

Flags: See RL r8

RLA

Rotate register A left through carry.

Cycles: 1

Bytes: 1

Flags:

Z

0

N

0

Н

0

C

Set according to result.

RLC r8

Rotate register r8 left.

Cycles: 2

Bytes: 2

Flags:

Z

Set if result is 0.

Ν

0

Н

0

C

Set according to result.

RLC [HL]

Rotate byte pointed to by **HL** left.

Cycles: 4

Bytes: 2

Flags: See RLC r8

RLCA

Rotate register A left.

Cycles: 1

Bytes: 1

Flags:

Z

0

Ν

0

Н

0

С

Set according to result.

RR r8

Rotate register r8 right through carry.

$$C \rightarrow [7 \rightarrow 0] \rightarrow C$$

Cycles: 2

Bytes: 2

Flags:

Z

Set if result is 0.

Ν

0

Н

0

С

Set according to result.

RR [HL]

Rotate byte pointed to by **HL** right through carry.

Cycles: 4

Bytes: 2

Flags: See RR r8

RRA

Rotate register A right through carry.

$$C \rightarrow [7 \rightarrow 0] \rightarrow C$$

Cycles: 1

Bytes: 1

Flags:

Z

0

N

0

Н

0

С

Set according to result.

RRC r8

Rotate register r8 right.

$$[0] \rightarrow [7 \rightarrow 0] \rightarrow C$$

Cycles: 2

Bytes: 2

Flags:

Z

Set if result is 0.

Ν

0

Н

0

c

Set according to result.

RRC [HL]

Rotate byte pointed to by HL right.

$$[0] \rightarrow [7 \rightarrow 0] \rightarrow C$$

Cycles: 4 Bytes: 2

Flags: See RRC r8

RRCA

Rotate register A right.

$$[0] \rightarrow [7 \rightarrow 0] \rightarrow C$$

Cycles: 1

Bytes: 1

Flags:

Z

0

Ν

0

Н

0

C

Set according to result.

RST vec

Call address vec. This is a shorter and faster equivalent to CALL for suitable values of vec.

Cycles: 4

Bytes: 1

Flags: None affected.

SBC A,r8

Subtract the value in r8 and the carry flag from A.

Cycles: 1

Bytes: 1

Flags:

Z

Set if result is 0.

Ν

1

Н

Set if borrow from bit 4.

C

Set if borrow (i.e. if (r8 + carry) > A).

SBC A,[HL]

Subtract the byte pointed to by **HL** and the carry flag from **A**.

Cycles: 2

Bytes: 1

Flags: See SBC A,r8

SBC A,n8

Subtract the value *n8* and the carry flag from **A**.

Cycles: 2

Bytes: 2

Flags: See SBC A,r8

SCF

Set Carry Flag.

Cycles: 1

Bytes: 1

Flags:

Ν

0

Н

0

C

1

SET u3,r8

Set bit u3 in register r8 to 1. Bit 0 is the rightmost one, bit 7 the leftmost one.

Cycles: 2

Bytes: 2

Flags: None affected.

SET u3,[HL]

Set bit u3 in the byte pointed by **HL** to 1. Bit 0 is the rightmost one, bit 7 the leftmost one.

Cycles: 4

Bytes: 2

Flags: None affected.

SLA r8

Shift Left Arithmetic register r8.

Cycles: 2

Bytes: 2

Flags:

Ζ

Set if result is 0.

Ν

0

Н

0

C

Set according to result.

SLA [HL]

Shift Left Arithmetic byte pointed to by HL.

Cycles: 4

Bytes: 2

Flags: See SLA r8

SRA_{r8}

Shift Right Arithmetic register r8.

$$[7] -> [7 -> 0] -> C$$

Cycles: 2

Bytes: 2

Flags:

Z

Set if result is 0.

Ν

0

Н

0

С

Set according to result.

SRA [HL]

Shift Right Arithmetic byte pointed to by HL.

$$[7] -> [7 -> 0] -> C$$

Cycles: 4

Bytes: 2

Flags: See SRA r8

SRL r8

Shift Right Logic register r8.

$$0 \rightarrow [7 \rightarrow 0] \rightarrow C$$

Cycles: 2

Bytes: 2

Flags:

Z

Set if result is 0.

Ν

0

Н

0

C

Set according to result.

SRL [HL]

Shift Right Logic byte pointed to by HL.

$$0 \rightarrow [7 \rightarrow 0] \rightarrow C$$

Cycles: 4

Bytes: 2

Flags: See SRA r8

STOP

Enter CPU very low power mode. Also used to switch between double and normal speed CPU modes in GBC.

Cycles: -

Bytes: 2

Flags: None affected.

SUB A,r8

Subtract the value in r8 from A.

Cycles: 1

Bytes: 1

Flags:

Z

Set if result is 0.

N

1

Н

Set if borrow from bit 4.

C

Set if borrow (set if r8 > A).

SUB A,[HL]

Subtract the byte pointed to by **HL** from **A**.

Cycles: 2

Bytes: 1

Flags: See SUB A,r8

SUB A,n8

Subtract the value n8 from A.

Cycles: 2

Bytes: 2

Flags: See SUB A,r8

SWAP r8

Swap upper 4 bits in register *r8* and the lower 4 ones.

```
Bytes: 2
Flags:

Z
Set if result is 0.

N
0
H
0
C
0
```

SWAP [HL]

Swap upper 4 bits in the byte pointed by ${\it HL}$ and the lower 4 ones.

Cycles: 4 Bytes: 2

Flags: See SWAP r8

XOR A,r8

Bitwise XOR between the value in r8 and A.

Cycles: 1 Bytes: 1

Flags:

Z

Set if result is 0.

N

Н

0

0

C 0

XOR A,[HL]

Bitwise XOR between the byte pointed to by **HL** and **A**.

Cycles: 2 Bytes: 1

Flags: See XOR A,r8

XOR A,n8

Bitwise XOR between the value in n8 and A.

Cycles: 2 Bytes: 2

Flags: See XOR A,r8

SEE ALSO

rgbasm(1), rgbds(7)

HISTORY

rgbds was originally written by Carsten Sørensen as part of the ASMotor package, and was later packaged in RGBDS by Justin Lloyd. It is now maintained by a number of contributors at https://github.com/rednex/rgbds.

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