

**NAME**

**gbz80** — CPU opcode reference

**DESCRIPTION**

This is the list of opcodes supported by `rgbasm(1)`, 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 it's register **A**. The following two lines have the same effect:

```
OR A,B
OR 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]
CP A,n8
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  
LD [\$FF00+n8],A  
LD [\$FF00+C],A  
LD A,[r16]  
LD A,[n16]  
LD A,\$FF00+n8  
LD A,\$FF00+C  
LD [HL+],A  
LD [HL-],A  
LD A,[HL+]  
LD A,[HL-]

#### 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**  
**DI**  
**EI**  
**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.
- **N**: 0
- **H**: Set if overflow from bit 3.
- **C**: Set if overflow from bit 7.

### **ADC A,[HL]**

Add the value pointed 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.
- **N**: 0
- **H**: Set if overflow from bit 3.
- **C**: Set if overflow from bit 7.

### **ADD A,[HL]**

Add the value pointed 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:

- **N**: 0
- **H**: Set if overflow from bit 11.
- **C**: 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
- **N**: 0
- **H**: 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**.

Cycles: 1

Bytes: 1

Flags:

- **Z**: Set if result is 0.
- **N**: 0

- **H:** 1
- **C:** 0

**AND A,[HL]**

Bitwise AND between the value pointed 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*.

Cycles: 6

Bytes: 3

Flags: None affected.

**CALL cc,n16**

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

Cycles: 6/3

Bytes: 3

Flags: None affected.

**CCF**

Complement Carry Flag.

Cycles: 1

Bytes: 1

Flags:

- **N**: 0
- **H**: 0
- **C**: Complemented.

**CP A,r8**

Subtract the value in *r8* from **A** and set flags accordingly, but don't store the result.

Cycles: 1

Bytes: 1

Flags:

- **Z**: Set if result is 0.
- **N**: 1
- **H**: Set if no borrow from bit 4.
- **C**: Set if no borrow (set if  $r8 > \mathbf{A}$ ).

**CP A,[HL]**

Subtract the value pointed 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.

Cycles: 2

Bytes: 2

Flags: See **CP A,r8**

**CPL**

Complement accumulator ( $\mathbf{A} = \sim\mathbf{A}$ ).

Cycles: 1

Bytes: 1

Flags:

- **N**: 1
- **H**: 1

**DAA**

Decimal adjust register A to get a correct BCD representation after an arithmetic instruction.

Cycles: 1

Bytes: 1

Flags:

- **Z**: Set if result is 0.
- **H**: 0
- **C**: 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.
- **N**: 1
- **H**: Set if no borrow from bit 4.

#### **DEC [HL]**

Decrement the value pointed 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.

Cycles: 1

Bytes: 1

Flags: None affected.

#### **EI**

Enable Interrupts.

Cycles: 1

Bytes: 1

Flags: None affected.

### **HALT**

Enter CPU low power mode.

Cycles: -

Bytes: 1

Flags: None affected.

### **INC r8**

Increment value in register *r8* by 1.

Cycles: 1

Bytes: 1

Flags:

- **Z**: Set if result is 0.
- **N**: 0
- **H**: Set if overflow from bit 3.

### **INC [HL]**

Increment the value pointed 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**

Absolute jump to address *n16*.

Cycles: 4

Bytes: 3

Flags: None affected.

**JP cc,n16**

Absolute jump to address *n16* if condition *cc* is met.

Cycles: 4/3

Bytes: 3

Flags: None affected.

**JP HL**

Jump to address in **HL**, that is, load **PC** with value in register **HL**.

Cycles: 1

Bytes: 1

Flags: None affected.

**JR e8**

Relative jump by adding *e8* to the current address.

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: 3/2

Bytes: 2

Flags: None affected.

**LD r8,r8**

Store 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 by register **HL**.

Cycles: 2

Bytes: 1

Flags: None affected.

**LD [HL],n8**

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

Cycles: 3

Bytes: 2

Flags: None affected.

**LD r8,[HL]**

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

Cycles: 2

Bytes: 1

Flags: None affected.

**LD [r16],A**

Store value in register **A** into address pointed by register *r16*.

Cycles: 2

Bytes: 1

Flags: None affected.

**LD [n16],A**

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

Cycles: 4

Bytes: 3

Flags: None affected.

**LD [\$FF00+n8],A**

Store value in register **A** into high RAM or I/O registers.

The following synonym forces this encoding: **LDH [\$FF00+n8],A**

Cycles: 3

Bytes: 2

Flags: None affected.

**LD [\$FF00+C],A**

Store value in register **A** into high RAM or I/O registers.

Cycles: 2

Bytes: 1

Flags: None affected.

**LD A,[r16]**

Load value in register **A** from address pointed by register *r16*.

Cycles: 2

Bytes: 1

Flags: None affected.

**LD A,[n16]**

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

Cycles: 4

Bytes: 3

Flags: None affected.

**LD A,[\$FF00+n8]**

Load value in register **A** from high RAM or I/O registers.

The following synonym forces this encoding: **LDH A,[\$FF00+n8]**

Cycles: 3

Bytes: 2

Flags: None affected.

**LD A,[\$FF00+C]**

Load value in register **A** from high RAM or I/O registers.

Cycles: 2

Bytes: 1

Flags: None affected.

**LD [HL+],A**

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

Cycles: 2

Bytes: 1

Flags: None affected.

**LD [HL-],A**

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

Cycles: 2

Bytes: 1

Flags: None affected.

**LD A,[HL+]**

Load value into register **A** from byte pointed by **HL** and post-increment **HL**.

Cycles: 2

Bytes: 1

Flags: None affected.

**LD A,[HL-]**

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

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** into addresses  $n16$  (LSB) and  $n16 + 1$  (MSB).

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
- **H**: 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**

Bitwise OR between 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]**

Bitwise OR between the value pointed by **HL** and **A**.

Cycles: 2

Bytes: 1

Flags: See **OR A,r8**

**OR A,n8**

Bitwise OR between the value in *n8* and **A**.

Cycles: 2

Bytes: 2

Flags: See **OR A,r8**

**POP AF**

Pop register **AF** from the stack.

Cycles: 3

Bytes: 1

Flags: None affected.

**POP r16**

Pop register *r16* from the stack.

Cycles: 3

Bytes: 1

Flags: None affected.

**PUSH AF**

Push register **AF** into the stack.

Cycles: 4

Bytes: 1

Flags: None affected.

**PUSH r16**

Push register *r16* into the stack.

Cycles: 4

Bytes: 1

Flags: None affected.

**RES u3,r8**

Set bit *u3* in register *r8* to 0.

Cycles: 2

Bytes: 2

Flags: None affected.

**RES u3,[HL]**

Set bit *u3* in the byte pointed by **HL** to 0.

Cycles: 4

Bytes: 2

Flags: None affected.

**RET**

Return from subroutine.

Cycles: 4

Bytes: 1

Flags: None affected.

**RET cc**

Return from subroutine if condition *cc* is met.

Cycles: 5/2

Bytes: 1

Flags: None affected.

**RETI**

Return from subroutine and enable interrupts.

Cycles: 4

Bytes: 1

Flags: None affected.

**RL r8**

Rotate register *r8* left through carry.

$$C \leftarrow [7 \leftarrow 0] \leftarrow C$$

Cycles: 2

Bytes: 2

Flags:

- **Z**: Set if result is 0.
- **N**: 0
- **H**: 0
- **C**: Set according to result.

**RL [HL]**

Rotate value pointed by **HL** left through carry.

$$C \leftarrow [7 \leftarrow 0] \leftarrow C$$

Cycles: 4

Bytes: 2

Flags: See **RL r8**

**RLA**

Rotate register **A** left through carry.

$$C \leftarrow [7 \leftarrow 0] \leftarrow C$$

Cycles: 1

Bytes: 1

Flags:

- **Z**: 0
- **N**: 0
- **H**: 0
- **C**: Set according to result.

**RLC r8**

Rotate register *r8* left.

$$C \leftarrow [7 \leftarrow 0] \leftarrow [7]$$

Cycles: 2

Bytes: 2

Flags:

- **Z**: Set if result is 0.
- **N**: 0
- **H**: 0
- **C**: Set according to result.

**RLC [HL]**

Rotate value pointed by **HL** left.

$$C \leftarrow [7 \leftarrow 0] \leftarrow [7]$$

Cycles: 4

Bytes: 2

Flags: See **RLC r8**

**RLCA**

Rotate register **A** left.

$$C \leftarrow [7 \leftarrow 0] \leftarrow [7]$$

Cycles: 1

Bytes: 1

Flags:

- **Z**: 0
- **N**: 0
- **H**: 0
- **C**: 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.
- **N**: 0
- **H**: 0
- **C**: Set according to result.

**RR [HL]**

Rotate value pointed by **HL** right through carry.

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

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
- **H**: 0
- **C**: Set according to result.

### **RRC r8**

Rotate register *r8* right.

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

Cycles: 2

Bytes: 2

Flags:

- **Z**: Set if result is 0.
- **N**: 0
- **H**: 0
- **C**: Set according to result.

### **RRC [HL]**

Rotate value pointed by **HL** right.

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

Cycles: 4

Bytes: 2

Flags: See **RRC r8**

### **RRCA**

Rotate register **A** right.

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

Cycles: 1

Bytes: 1

Flags:

- **Z**: 0
- **N**: 0
- **H**: 0
- **C**: Set according to result.

### **RST vec**

Call restart vector *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.
- **N**: 1
- **H**: Set if no borrow from bit 4.
- **C**: Set if no borrow (set if  $r8 > A$ ).

### **SBC A,[HL]**

Subtract the value pointed 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:

- **N**: 0
- **H**: 0
- **C**: 1

### **SET u3,r8**

Set bit *u3* in register *r8* to 1.

Cycles: 2

Bytes: 2

Flags: None affected.

### **SET u3,[HL]**

Set bit *u3* in the byte pointed by **HL** to 1.

Cycles: 4

Bytes: 2

Flags: None affected.

**SLA r8**

Shift left arithmetic register *r8*.

$$C \leftarrow [7 \leftarrow 0] \leftarrow 0$$

Cycles: 2

Bytes: 2

Flags:

- **Z**: Set if result is 0.
- **N**: 0
- **H**: 0
- **C**: Set according to result.

**SLA [HL]**

Shift left arithmetic value pointed by **HL**.

$$C \leftarrow [7 \leftarrow 0] \leftarrow 0$$

Cycles: 4

Bytes: 2

Flags: See **SLA r8**

**SRA r8**

Shift right arithmetic register *r8*.

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

Cycles: 2

Bytes: 2

Flags:

- **Z**: Set if result is 0.
- **N**: 0
- **H**: 0
- **C**: Set according to result.

**SRA [HL]**

Shift right arithmetic value pointed by **HL**.

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

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.
- **N**: 0
- **H**: 0
- **C**: Set according to result.

#### **SRL [HL]**

Shift right logic value pointed by **HL**.

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

Cycles: 4

Bytes: 2

Flags: See **SRA r8**

#### **STOP**

Enter CPU very low power mode. Also used to switch between double speed and normal 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
- **H**: Set if no borrow from bit 4.
- **C**: Set if no borrow (set if *r8* > **A**).

#### **SUB A,[HL]**

Subtract the value pointed 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 ones.

Cycles: 2

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 **HL** and the lower 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**: 0
- **H**: 0
- **C**: 0

**XOR A,[HL]**

Bitwise XOR between the value pointed 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/red->

nex/rgbds.