

# DIGIRULE2



# USER MANUAL

**PLEASE NOTE THIS DOCUMENT IS A WORK IN PROGRESS AND  
WILL BE COMPLETED BEFORE KICKSTARTER BACKERS  
ACTUALLY RECEIVE THEIR DIGIRULE2 REWARDS.**

# INSTRUCTION SET SUMMARY

Number	Instruction	Description	Bytes	Flags
0	COPYLR	Copy a literal value to the specified RAM location	3	None
1	COPYLA	Copy a literal value to the Accumulator	2	None
2	COPYAR	Copy the contents of the Accumulator to the specified RAM location	2	None
3	COPYRA	Copy the contents of the specified RAM location to the Accumulator	2	Zero
4	COPYRR	Copy the contents of one RAM location to another RAM location	3	Zero
5	ADDLA	Add a literal value to the Accumulator (result stored in Accumulator)	2	Carry, Zero
6	ADDRA	Add the contents of a RAM location to the Accumulator (result stored in Accumulator)	2	Carry, Zero
7	SUBLA	Subtract a literal value from the Accumulator (result stored in the Accumulator)	2	Carry, Zero
8	SUBRA	Subtract the contents of the specified RAM location from the Accumulator (result stored in Accumulator)	2	Carry, Zero
9	ANDLA	AND a literal value with the Accumulator (result stored in Accumulator)	2	Zero
10	ANDRA	AND the contents of the specified RAM location with the Accumulator (result stored in Accumulator)	2	Zero
11	ORLA	OR a literal value with the Accumulator (result stored in Accumulator)	2	Zero
12	ORRA	OR the contents of the specified RAM location with the Accumulator (result stored in Accumulator)	2	Zero
13	XORLA	XOR a literal value with the Accumulator (result stored in Accumulator)	2	Zero
14	XORRA	XOR the contents of the specified RAM location with the Accumulator (result stored in Accumulator)	2	Zero
15	DECR	Decrement the contents of the specified RAM location by one	2	Zero
16	INCR	Increment the contents of the specified RAM location by one	2	Zero
17	DECRJZ	Decrement the contents of the specified RAM location by one, if the result IS zero, skip the next two lines of code	2	Zero
18	INCRJZ	Increment the contents of the specified RAM location by one, if the result IS zero, skip the next two lines of code	2	Zero
19	SHIFTRL	Shift the contents of the specified RAM location left (through the carry flag) by one	2	Carry
20	SHIFTRR	Shift the contents of the specified RAM location right (through the carry flag) by one	2	Carry
21	CBR	Clear the specified bit within the specified RAM location	3	None
22	SBR	Set the specified bit within the specified RAM location	3	None
23	BCRSC	Check the specified bit within the specified RAM location, if it IS a ZERO, skip the next two lines of code	3	None
24	BCRSS	Check the specified bit within the specified RAM location, if it IS a ONE, skip the next two lines of code	3	None
25	JUMP	Jump to a specific RAM location and continue running instructions from there	2	None
26	CALL	Jump to a specific RAM location, continue running instructions from there, then return once a 'RETURN' or 'RETLA' instruction is executed	2	None
27	RETLA	Return to the very next RAM location after the 'CALL' instruction with a literal value stored in the Accumulator	2	None
28	RETURN	Return to the very next RAM location after the 'CALL' instruction	1	None
29	HALT	Stop executing instructions (performs the same task as pressing the CPU RUN/STOP button)	1	None
30	SPEED	Set the speed that the CPU steps through each instruction once the CPU is running	2	None
31	NOP	No operation	1	None
32	ADDRPC	Add the contents of a RAM location to the Program Counter	2	None

# INSTRUCTION SET

## 0. COPYLR

**Description:** Copy a literal value to the specified RAM location

**Usage:** [COPYLR] [Value to copy] [RAM location to store the Value]

**Program Bytes Used:** 3

**Status Flags Affected:** None

**Example 1:** Copy the number 35 (binary 00100011) to RAM location 240 (binary 11110000)

**Pre-conditions:** RAM location 240 = 0 (binary 00000000)

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYLR	00000000	0
00000001	35	00100011	35
00000010	240	11110000	240

**Post-conditions:** RAM location 240 = 35 (binary 00100011)

**Example 2:** Copy the number 82 (binary 01010010) to 'myVariable' ('myVariable' is an alias for RAM location 241)

**Pre-conditions:** 'myVariable' = 15 (binary 00001111)

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYLR	00000000	0
00000001	82	01010010	82
00000010	myVariable	11110001	241

**Post-conditions:** 'myVariable' = 82 (binary 01010010)

## 1. COPYLA

**Description:** Copy a literal value to the Accumulator.

**Usage:** [COPYLA] [Value to copy]

**Program Bytes Used:** 2

**Status Flags Affected:** None

**Example 1:** Copy the number 123 (binary 01111011) to the Accumulator

**Pre-conditions:** Accumulator = 16 (binary 00010000)

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYLA	00000001	1
00000001	123	01111011	123

**Post-conditions:** Accumulator = 123 (binary 01111011)

## 2. COPYAR

**Description:** Copy the contents of the Accumulator to the specified RAM location

**Usage:** [COPYAR] [RAM location to store the number]

**Program Bytes Used:** 2

**Status Flags Affected:** None

**Example 1:** Copy the contents of the Accumulator to RAM location 250 (binary 11111100).

**Pre-conditions:** Accumulator = 2 (binary 00000010)  
RAM location 250 (binary 11111010) = 7 (binary 00000111)

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYAR	00000010	2
00000001	250	11111010	250

**Post-conditions:** Accumulator = 2 (binary 00000010)  
RAM location 250 (binary 11111010) = 2 (binary 00000010)

**Example 2:** Copy the contents of the Accumulator to 'myVariable' ('myVariable' is an alias for RAM location 252)

**Pre-conditions:** Accumulator = 129 (binary 10000001)  
'myVariable' = 20 (binary 00010100)

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYAR	00000010	2
00000001	252	11111100	252

**Post-conditions:** Accumulator = 129 (binary 10000001)  
'myVariable' = 129 (binary 10000001)

### 3. COPYRA

**Description:** Copy the contents of the specified RAM location to the Accumulator

**Usage:** [COPYRA] [RAM location to copy the value from]

**Program Bytes Used:** 2

**Status Flags Affected:** Zero Flag

**Example 1:** Copy the contents of RAM location 243 (binary 11110011) to the Accumulator

**Pre-conditions:** Accumulator = 16 (binary 00010000)  
RAM location 243 (binary 11110011) = 127 (binary 01111111)  
Zero Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYRA	00000011	3
00000001	243	11110011	243

**Post-conditions:** Accumulator = 127 (binary 01111111)  
RAM location 243 (binary 11110011) = 127 (binary 01111111)  
Zero Flag = 0

**Example 2:** Copy the contents of 'myVariable' to the accumulator

**Pre-conditions:** Accumulator = 56 (binary 00111000)  
'myVariable' = 32 (binary 00100000)

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYRA	00000011	3
00000001	myVariable	11111101	252

**Post-conditions:** Accumulator = 32 (binary 00100000)  
'myVariable' = 32 (binary 00100000)

## 4. COPYRR

**Description:** Copy the contents of one RAM location to another

**Usage:** [COPYRR] [RAM location to copy the value from] [RAM location to copy the value to]

**Program Bytes Used:** 3

**Status Flags Affected:** Zero Flag

**Example 1:** Copy the contents of RAM location 252 (binary 11111100) to RAM location 253 (binary 11111101)

**Pre-conditions:** RAM location 252 (binary 11111100) = 10 (binary 00001010)  
RAM location 253 (binary 11111101) = 0 (binary 00000000)  
Zero Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYRR	00000100	4
00000001	252	11111100	252
00000010	253	11111101	253

**Post-conditions:** RAM location 252 (binary 11111100) = 10 (binary 00001010)  
RAM location 253 (binary 11111101) = 10 (binary 00001010)  
Zero Flag = 0

**Example 2:** Copy the contents of 'myVariable' to 'myOtherVariable' ('myVariable' is an alias for RAM location 244 while 'myOtherVariable' is an alias for RAM location 245)

**Pre-conditions:** 'myVariable' = 0 (binary 00000000)  
'myOtherVariable' = 25 (binary 00011001)  
Zero Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	COPYRR	00000100	4
00000001	myVariable	11110100	244
00000010	myOtherVariable	11110101	245

**Post-conditions:** 'myVariable' = 0 (binary 00000000)  
'myOtherVariable' = 0 (binary 00000000)  
Zero Flag = 1

## 5. ADDLA

**Description:** Add a literal value to the Accumulator

**Usage:** [ADDLA] [Value to add]

**Program Bytes Used:** 2

**Status Flags Affected:** Zero Flag, Carry Flag

**Example 1:** Add the literal value 15 (binary 00001111) to the Accumulator

**Pre-conditions:** Accumulator = 0 (binary 00000000)  
Zero Flag = 1  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	ADDLA	00000101	5
00000001	15	00001111	15

**Post-conditions:** Accumulator = 15 (binary 00001111)  
Zero Flag = 0  
Carry Flag = 0

**Example 2:** Add the literal value 16 (binary 00010000) to the Accumulator

**Pre-conditions:** Accumulator = 255 (binary 11111111)  
Zero Flag = 0  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	ADDLA	00000101	5
00000001	1	00000001	1

**Post-conditions:** Accumulator = 0 (binary 00000000)  
Zero Flag = 1  
Carry Flag = 1

## 6. ADDRA

**Description:** Add the value contained within a RAM location to the Accumulator

**Usage:** [ADDRA] [RAM location of value to add to the Accumulator]

**Program Bytes Used:** 2

**Status Flags Affected:** Zero Flag, Carry Flag

**Example 1:** Add the value stored within RAM location 250 (binary 11111010) to the Accumulator

**Pre-conditions:** Accumulator = 100 (binary 01100100)  
RAM location 250 (binary 11111010) = 100 (binary 01100100)  
Zero Flag = 0  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	ADDRA	00000110	6
00000001	250	11111010	250

**Post-conditions:** Accumulator = 200 (binary 11001000)  
RAM location 250 (binary 11111010) = 100 (binary 01100100)  
Zero Flag = 0  
Carry Flag = 0

**Example 2:** Add the value stored within 'myVariable' to the Accumulator ('myVariable' is an alias for RAM location 249)

**Pre-conditions:** Accumulator = 40 (binary 00101000)  
'myVariable' = 72 (binary 01001000)  
Zero Flag = 0  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	ADDRA	00000110	6
00000001	myVariable	11111001	249

**Post-conditions:** Accumulator = 112 (binary 01110000)  
'myVariable' = 72 (binary 01001000)  
Zero Flag = 0  
Carry Flag = 0

## 7. SUBLA

**Description:** Subtract a literal value from the Accumulator

**Usage:** [SUBLA] [Value to subtract]

**Program Bytes Used:** 2

**Status Flags Affected:** Zero Flag, Carry Flag

**Example 1:** Subtract the literal value 20 (binary 00010100) from the Accumulator

**Pre-conditions:** Accumulator = 20 (binary 00010100)  
Zero Flag = 0  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	SUBLA	00000111	7
00000001	20	00010100	20

**Post-conditions:** Accumulator = 0 (binary 00000000)  
Zero Flag = 1  
Carry Flag = 0

**Example 2:** Subtract the literal value 41 (binary 00101001) from the Accumulator

**Pre-conditions:** Accumulator = 40 (binary 00101000)  
Zero Flag = 0  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	SUBLA	00000111	7
00000001	20	00010100	20

**Post-conditions:** Accumulator = 1 (binary 00000001)  
Zero Flag = 0  
Carry Flag = 1

## 8. SUBRA

**Description:** Subtract the value stored in a RAM location, from the Accumulator

**Usage:** [SUBRA] [RAM location of value to subtract from the Accumulator]

**Program Bytes Used:** 2

**Status Flags Affected:** Zero Flag, Carry Flag

**Example 1:** Subtract the value stored within RAM location 250 (binary 11111010) from the Accumulator

**Pre-conditions:** Accumulator = 201 (binary 11001001)  
RAM location 250 (binary 11111010) = 34 (binary 00100010)  
Zero Flag = 0  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	SUBRA	00001000	8
00000001	250	11111010	250

**Post-conditions:** Accumulator = 167 (binary 11001000)  
RAM location 250 (binary 11111010) = 34 (binary 00100010)  
Zero Flag = 0  
Carry Flag = 0

**Example 2:** Subtract the value stored within 'myVariable' from the Accumulator ('myVariable' is an alias for RAM location 245)

**Pre-conditions:** Accumulator = 255 (binary 11111111)  
'myVariable' = 255 (binary 11111111)  
Zero Flag = 0  
Carry Flag = 0

PC Binary	Instruction	Machine Code (Binary)	Machine Code (Decimal)
00000000	SUBRA	00001000	8
00000001	myVariable	11110101	245

**Post-conditions:** Accumulator = 0 (binary 00000000)  
'myVariable' = 255 (binary 11111111)  
Zero Flag = 1  
Carry Flag = 0