MODBUS REGISTER MANUAL

MSC

Multifunction Smart Calibrator

SENECA S.r.l.
Via Austria 26 – 35127 – Z.I. - PADOVA (PD) - ITALY
Tel. +39.049.8705355 – 8705355 Fax +39 049.8706287
www.seneca.it

ORIGINAL INSTRUCTIONS

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Introduction

The content of this documentation refers to products and technologies described in it.
All technical data contained in the document may be changed without notice.
The content of this documentation is subject to periodic review.
To use the product safely and effectively, read the following instructions carefully before use.
The product must be used only for the use for which it was designed and manufactured: any other use is under the full responsibility of the user.
Installation, programming and set-up are allowed only to authorized operators, physically and intellectually suitable.
The set-up must be performed only after a correct installation and the user must follow all the operations described in the installation manual carefully.
Seneca is not responsible for failures, breakages and accidents caused by ignorance or failure to apply the indicated requirements.
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There may be errors and inaccuracies in this document that could damage your system, so proceed with caution, the author(s) will not take responsibility for it.
Technical specifications are subject to change without notice.

CONTACT US	
Technical support	supporto@seneca.it
Product information	commerciale@seneca.it

Document revisions

DATE	REVISION	NOTES	AUTHOR
03/07/2019	1.0.0.2	First revision	MM
11/07/19	1.0.0.3	Fix: RTD Generation only with 2 wire	MM

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1. *INTRODUCTION*

ATTENTION!

This user manual extends the information from the installation manual to the configuration of the device. Use the installation manual for more information.

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In any case, SENECA s.r.l. or its suppliers will not be responsible for the loss of data/revenue or consequential or incidental damages due to negligence or bad/improper management of the device, even if SENECA is well aware of these possible damages.
SENECA, its subsidiaries, affiliates, group companies, suppliers and distributors do not guarantee that the functions fully meet the customer's expectations or that the device, firmware and software should have no errors or operate continuously.

1.1. DESCRIPTION

The MSC product has registers to be controlled by the USB port or by Bluetooth, in this way it is possible to control the device to read or generate electrical quantities.
The protocol supported by MSC is Modbus RTU slave.
The purpose of this manual is to provide registers for the complete control of MSC so as to be integrated into third-party software.
For .NET developers there are various libraries for the Modbus RTU protocol (for example the Open Source NModbus library is available at this address: https://github.com/NModbus/NModbus)

2. USB PORT AND DRIVERS

The USB port allows a simple connection using the Modbus RTU slave protocol, the communication parameters for the USB port cannot be modified:

Baud rate: 115200
Address of the RTU Modbus station: 25
Data Bit: 8
Stop bit: 1

The USB port is CDC standard-type, for operating systems other than Windows it is therefore possible to use a generic CDC drivers.

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The USB is seen as a virtual com port via the drivers for Windows 7, Windows 8, Windows 10 (they can be downloaded from the device's Web page and are, however, automatically installed with the SENECA MSC software).

The protocol available through the USB port is Modbus RTU Slave.

3. MODBUS RTU SLAVE PROTOCOL

For more information on the Modbus RTU slave protocol, see the website: http://www.modbus.org/specs.php.

3.1. TYPE OF 32-BIT FLOATING POINT DATA (REAL 32)

Some MSC registers are in Floating Point 32 format according to the IEE754 standard, for more information on the type of Real 32 bit data refer to the following website:
https://en.wikipedia.org/wiki/IEEE_754

As to online conversion tools, refer to the website:
https://www.h-schmidt.net/FloatConverter/IEEE754.html

REAL 32-BIT MSW DATA TYPE (FLOATING POINT IEEE-754)	
RANGE	1.175495e−38 / 3.40282346e+38
NUMBER OF HOLDING REGISTER MODBUS REGISTERS	2

Occupying 2 modbus registers, the data is represented as follows:

ADDRESS REGISTER n	Most significant part
ADDRESS REGISTER n+1	Least significant part

3.2. GENERAL REGISTERS

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE*	*Unit of Measure*
40147	146	Number of seconds remaining to auto switch-off	16 bit without sign	Seconds
40175-176	174-175	Measurement of battery voltages in mV	Floating Point	mV

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4. USE OF MSC TO TAKE MEASUREMENTS

4.1. MEASUREMENT MIN/MAX/AVG VALUES

To reset the Min/Max/Avg values, write the value 5 on CMD register
To pause the Min/Max/Avg values write the value 10 in the CMD register

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40108	107	CMD	16 bit without sign

4.2. DATALOGGER

It is possible to control the datalogger start/stop in this way:

COMMAND	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
DATALOGGER START	1	3
DATALOGGER STOP	0	3

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40108	107	CMD	16 bit without sign
40109	108	AUX1	16 bit without sign

REGISTER ADDRESS	REGISTER (OFFSET)	VARIABLE	VARIABLE TYPE	Unit of Measure
40195-196	194-195	Dimensions of the datalogger file in bytes	32 bit without sign	Byte

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4.3. DIAGNOSTICS REGISTER FOR MEASUREMENTS

The reading diagnostics register is:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE TYPE*	*Unit of Measure*
40103	102	Diagnostics	16 bit without sign	-

The bit indicating a measurement error is

BIT 16	BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1
-	-	MEASUREMENT ERROR	-	-	-	-	-	-	-	-	-	-	-	-	-

Where if the MEASUREMENT ERROR bit:
is 1 -> Measurement error
is 0 -> Measurement OK

4.4. CURRENT/VOLTAGE MEASUREMENTS

The type of measurement is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	*REGISTER (OFFSET)*	*REGISTER NAME*	*REGISTER TYPE*
40108	107	CMD	16 bit without sign
40109	108	AUX1	16 bit without sign

The values to write in the registers for the different types of measurement are:

TYPE OF MEASUREMENT	*AUX1 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
CURRENT PASSIVE 0..20 mA	1	1
CURRENT ACTIVE 0..20 mA	2	1
VOLTAGE 0..27 V	3	1
VOLTAGE -10..90 mV	4	1

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Reading registers:

REGISTER ADDRESS	***REGISTER (OFFSET)***	***VARIABLE***	***VARIABLE TYPE***	***Unit of Measure***
40137-40138	136-137	Measurement value	Floating Point	mA / V / mV
40133-40134	132-133	Minimum value	Floating Point	mA / V / mV
40135-40136	134-135	Maximum value	Floating Point	mA / V / mV
40171-40172	170-171	Medium value	Floating Point	mA / V / mV

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4.5. THERMOCOUPLE MEASUREMENTS

The type of thermocouple is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	*REGISTER (OFFSET)*	*REGISTER NAME*	*REGISTER TYPE*
40108	107	CMD	16 bit without sign
40109	108	AUX1	16 bit without sign

The values to write in the registers to select the type of thermocouple are:

THERMOCOUPLE TYPE	*AUX1 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
J	5	1
K	6	1
T	7	1
E	8	1
L	9	1
N	10	1
R	11	1
S	12	1
B	13	1

Reading registers:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE TYPE*	*Unit of Measure*
40137-40138	136-137	Temperature	Floating Point	°C
40117-40118	116-117	Cold junction voltage	Floating Point	mV
40127-40128	126-127	Cold junction temperature	Floating Point	°C
40133-40134	132-133	Minimum temperature	Floating Point	°C
40135-40136	134-135	Maximum temperature	Floating Point	°C
40171-40172	170-171	Average temperature	Floating Point	°C

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4.6. THERMORESISTANCE (RTD) MEASUREMENTS

The type of thermoresistence is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	*REGISTER (OFFSET)*	*REGISTER NAME*	*REGISTER TYPE*
40108	107	CMD	16 bit without sign
40109	108	AUX1	16 bit without sign

The values to write in the registers to select the type of resistance thermometer are:

THERMORESISTENCE TYPE	*AUX1 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
PT100 2 WIRES	14	1
PT100 3 WIRES	15	1
PT100 4 WIRES	16	1
PT500 2 WIRES	17	1
PT500 3 WIRES	18	1
PT500 4 WIRES	19	1
PT1000 2 WIRES	20	1
PT1000 4 WIRES	22	1
PT1000 4 WIRES	22	1
PT1000 4 WIRES	22	1
CU50 2 WIRES	23	1
CU50 3 WIRES	24	1
CU50 4 WIRES	25	1
CU100 2 WIRES	26	1
CU100 3 WIRES	27	1
CU100 4 WIRES	28	1
NI100 2 WIRES	29	1
NI100 3 WIRES	30	1
NI100 4 WIRES	31	1
NI120 2 WIRES	32	1
NI120 3 WIRES	33	1
NI120 4 WIRES	34	1

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Reading registers:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE TYPE*	*Unit of Measure*
40137-40138	136-137	Temperature	Floating Point	°C
40131-40132	130-131	Resistance	Floating Point	Ohm
40133-40134	132-133	Minimum temperature	Floating Point	°C
40135-40136	134-135	Maximum temperature	Floating Point	°C
40171-40172	170-171	Average temperature	Floating Point	°C

4.7. LOAD CELL MEASUREMENT

The type of load cell measurement is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	*REGISTER (OFFSET)*	*REGISTER NAME*	*REGISTER TYPE*
40108	107	CMD	16 bit without sign
40109	108	AUX1	16 bit without sign

The values to write in the registers to select the type of load cell measurement are:

TYPE OF MEASUREMENT	*AUX1 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
LOAD CELL	35	1

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The measurement is expressed in mV/V and is only gross (tare + net weight):

Reading registers:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE TYPE*	*Unit of Measure*
40137-40138	136-137	Cell unbalance measurement	Floating Point	mV/V

If the cell is completely unbalanced the measurement is 2 mV/V so the gross weight coincides with the full scale of the cell.

The gross weight can then be calculated according to the formula:

Gross Weight [Kg] = (Cell Full Scale [Kg] * Cell Unbalance Measurement [mV/V]) / 2

For example, if the load cell has a full scale of 100 kg and the unbalance measurement is 1 mV/V you will have:

Gross Weight [Kg] = (100 Kg * 1 mV/V) / 2 = 50 Kg

4.8. FREQUENCY MEASUREMENT

The type of frequency measurement is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	*REGISTER (OFFSET)*	*REGISTER NAME*	*REGISTER TYPE*
40108	107	CMD	16 bit without sign
40109	108	AUX1	16 bit without sign

The values to write in the registers to select the type of load cell measurement are:

TYPE OF MEASUREMENT	*AUX1 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
LOAD CELL MEASUREMENT	36	1

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Reading registers:

REGISTER ADDRESS	REGISTER (OFFSET)	VARIABLE	VARIABLE TYPE	Unit of Measure
40165-166	164-165	Frequency	Floating Point	Hz

4.9. PULSE NUMBER MEASUREMENT

The type of pulse measurement is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40108	107	CMD	16 bit without sign
40109	108	AUX1	16 bit without sign

The values to write in the registers to select the type of pulse measurement are:

TYPE OF MEASUREMENT	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
LOAD CELL MEASUREMENT	37	1

Reading registers:

REGISTER ADDRESS	REGISTER (OFFSET)	VARIABLE	VARIABLE TYPE	Unit of Measure
40153-154	152-153	Pulse number with Positive Fronts	32 bit without sign	Pulse No.
40151-152	150-151	Pulse number with Negative Fronts	32 bit without sign	Pulse No.

To reset the pulse value counted, write the value 5 in the CMD register
To pause the count of the pulses, write the value 10 in the CMD register

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REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40108	107	CMD	16 bit without sign

5. USE OF MSC TO GENERATE SIGNALS

5.1. DIAGNOSTICS REGISTER FOR GENERATIONS

The generation diagnostics register is:

REGISTER ADDRESS	REGISTER (OFFSET)	VARIABLE	VARIABLE TYPE	Unit of Measure
40103	102	Diagnostics	16 bit without sign	-

The bit indicating a measurement error is

BIT 16	BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1
GENERATION ERROR	SELF-READING ERROR	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Where if:
The SELF-READING ERROR bit:
is 1 -> Self-reading error of the current generation
is 0 -> Generation OK

The GENERATION ERROR bit:
is 1 -> Generation error
is 0 -> Generation OK

5.2. CURRENT AND VOLTAGE GENERATION

The type of generation is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40208	207	CMD	16 bit without sign
40209	208	AUX1	16 bit without sign

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The values to write in the registers for the different types of measurement are:

GENERATION TYPE	*AUX1 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
PASSIVE CURRENT 0..20 mA	101	1
ACTIVE CURRENT 0..20 mA	102	1
VOLTAGE 0..27 V	103	1
VOLTAGE -10..90 mV	104	1

Writing registers (the written value is generated to the terminals) for the currents:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE TYPE*	*Unit of Measure*
40137-40138	136-137	Current value to be generated	Floating Point	mA

Writing registers (the written value is generated to the terminals) for the voltages:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE TYPE*	*Unit of Measure*
40213-40214	212-2016	Voltage value to be generated	Floating Point	V / mV

5.3. THERMOCOUPLE SIGNAL GENERATION

Configuration of the cold junction:

COLD JUNCTION	*AUX1 REGISTER WRITING VALUE*	*AUX2 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
INTERNAL TO MSC	2	1	2
EXTERNAL TO MSC	1	1	2

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Where:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*REGISTER NAME*	*REGISTER TYPE*
40209	208	AUX1	16 bit without sign
40210	209	AUX2	16 bit without sign
40208	207	CMD	16 bit without sign

In case of manual cold junction compensation, it is possible to enter the compensation value in mV in the register:

REGISTER ADDRESS	*REGISTER (OFFSET)*	*VARIABLE*	*VARIABLE TYPE*	*Unit of Measure*
40241-40242	240-241	Manual cold junction value	Floating Point	mV

The type of thermocouple is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	*REGISTER (OFFSET)*	*REGISTER NAME*	*REGISTER TYPE*
40208	207	CMD	16 bit without sign
40209	208	AUX1	16 bit without sign

The values to write in the registers to select the type of thermocouple are:

THERMOCOUPLE TYPE	*AUX1 REGISTER WRITING VALUE*	*CMD REGISTER WRITING VALUE*
J	105	1
K	106	1
T	107	1
E	108	1
L	109	1
N	110	1
R	111	1
S	112	1
B	113	1

Writing Registers of the value to be generated:

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REGISTER ADDRESS	REGISTER (OFFSET)	VARIABLE	VARIABLE TYPE	Unit of Measure
40221-40222	220-221	Temperature to be generated	Floating Point	°C

5.4. THERMORESISTANCE (RTD) SIGNAL GENERATION

The type of thermoresistance is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40208	207	CMD	16 bit without sign
40209	208	AUX1	16 bit without sign

The values to write in the registers to select the type of resistance thermometer are:

THERMORESISTANCE TYPE	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
PT100 2 WIRES	114	1
PT500 2 WIRES	117	1
PT1000 2 WIRES	120	1
CU50 2 WIRES	123	1
CU100 2 WIRES	126	1
NI100 2 WIRES	129	1
NI120 2 WIRES	132	1

Writing Registers of the value to be generated:

REGISTER ADDRESS	REGISTER (OFFSET)	VARIABLE	VARIABLE TYPE	Unit of Measure
40229-40230	228-229	Temperature	Floating Point	°C

6. LOAD CELL GENERATION

The type of load cell generation is selected by writing the AUX1 register followed by the CMD register

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REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40208	207	CMD	16 bit without sign
40209	208	AUX1	16 bit without sign

GENERATION TYPE	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
LOAD CELL	135	1

The unbalance of the cell must be entered in the register:

REGISTER ADDRESS	REGISTER (OFFSET)	VARIABLE	VARIABLE TYPE	Unit of Measure
40215-40216	214-215	Cell unbalance	Floating Point	mV/V

To generate a value in Kg (gross), use the following relation:

Cell unbalance [mV/V] = (gross Kg to be generated * 2) / Cell Full Scale [Kg]

For example, if you want to simulate a load cell with 100 kg full scale and want to generate 25 gross kg, you will have:

Cell unbalance [mV/V] = (25 Kg * 2) / 100 Kg = 0.5 mV/V

7. FREQUENCY

The type of frequency generation is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40208	207	CMD	16 bit without sign
40209	208	AUX1	16 bit without sign

GENERATION TYPE	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
FREQUENCY	136	1

The frequency value to generate is obtained by writing four registers:

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REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40255-40256	254-255	TICK1	32 bit without sign
40257-40258	256-257	TICK2	32 bit without sign
40263-40264	262-263	% HIGH VOLTAGE	Floating Point 32 bit
40265-40266	264-265	% LOW VOLTAGE	Floating Point 32 bit

Where:

TEMP = Math.Round((20000/ Frequency to generate [Hz]),0)
TICK1 = Math.Floor(TEMP/2)
TICK2 = TEMP-TICK1
% HIGH VOLTAGE is the voltage percentage value of when the signal must be high (0.0 = 0%, 1.0 = 100%) referred to 27V (100%)
% LOW VOLTAGE is the voltage percentage value of when the signal must be low (0.0 = 0%, 1.0 = 100%) referred to 27V (100%)

COMMAND	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
GENERATION START	1	9

Example:

If you want to generate a 100 Hz frequency with 0-5V band:
TEMP = Math.Round((20000/ 100 [Hz]),0) = 200
TICK1 = Math.Floor(200/2) = 100
TICK2 = 200-100=100
% HIGH VOLTAGE = 0
% LOW VOLTAGE = 0.185

8. NUMBER OF PULSES GENERATION

The type of pulse generation is selected by writing the AUX1 register followed by the CMD register

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40208	207	CMD	16 bit without sign
40209	208	AUX1	16 bit without sign

GENERATION TYPE	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
FREQUENCY	137	1

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The number of pulses to generate is obtained by writing 5 registers:

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40253-40254	252-253	PULSE No. (x2)	32 bit without sign
40255-40256	254-255	TICK1	32 bit without sign
40257-40258	256-257	TICK2	32 bit without sign
40263-40264	262-263	% HIGH VOLTAGE	Floating Point 32 bit
40265-40266	264-265	% LOW VOLTAGE	Floating Point 32 bit

Where:

No. OF PULSES (x2) = Number of pulses to generate multiplied by 2
TICK1 = Duration of the High pulse in how many 50 ms
TICK2 = Duration of the Low pulse in how many 50 ms
% HIGH VOLTAGE is the voltage percentage value of when the signal must be high (0.0 = 0%, 1.0 = 100%) referred to 27V (100%)
% LOW VOLTAGE is the voltage percentage value of when the signal must be low (0.0 = 0%, 1.0 = 100%) referred to 27V (100%)

COMMAND	AUX1 REGISTER WRITING VALUE	CMD REGISTER WRITING VALUE
GENERATION START WITH LOW START	2	9
GENERATION START WITH HIGH START	3	9
PAUSE / START	4	9

The number of pulses still to generate is represented in the reading register:

REGISTER ADDRESS	REGISTER (OFFSET)	REGISTER NAME	REGISTER TYPE
40251-40252	250-251	REMAINING PULSES / 2	32 bit without sign

This value must be divided by 2 to obtain the number of remaining pulses.

Example:

If you want to generate 500 pulses lasting 500ms High and 500ms Low with 0-10V band:

No. OF PULSES (x2) = 1000
TICK1 = 10
TICK2 = 10
% HIGH VOLTAGE = 0.37

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% LOW VOLTAGE = 0.0

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