



GANGES – SOLAR CLEANER
API DOCUMENT
(RTI-EM-DOC1100-API-RV01)

Revision History

Rev	Date	Change Description	Prepared By	Verified By	Approved By
00	29.04.2022		Dinesh, Shathik	Venkat	
01	27.07.2022	Changes in API (101C)	Dinesh		



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GANGES-SOLAR CLEANER

Overview

The system contains one communication gateway, Track changer and Cleaner hardware. The Track changer (TC) and the cleaner are connected wirelessly through ZIGBEE network to the communication gateway. Any command between the TC and the Cleaner are done through the communication gateway.

This document explains the API for configuration and control of the gateway through the communication interface available on the gateway with Cleaner unit (End Device). JSON Format is used as the standard communication format. The Gateway is mentioned as “Device” in the documentation, controller Board is mentioned as “End Device” and the host communication device is commonly mentioned as the “Host”.

The following table describes the common parameters used in most of the communication frames. More specific parameters are explained with the respective APIs.

Parameters	Usage
DID	Unique end device (Robot) identification number. This is unique to every end device manufactured. It's also the Zigbee Address. Length = 8 characters (Hexadecimal Number as string)
CMD	Command conveys the operation to be performed with the current message frame. The different commands are defined in the following section. Length = 4 characters (Hexadecimal Number as string)

Existing Commands

Following are the different commands that can be used in the CMD field of respective messages.

D-> H => Device to Host, D <- H => Host to Device, D <-> H => Device to Host and Host to Device.

S.NO	OPERATION	COMMAND	DIRECTION
1	Set Mode –Auto/Manual	0001	H → D
2	Set Manual Control	0003	H → D
3	Set motor PWM Value - Manual Mode	0004	H → D
4	Set Motor Status	0005	H → D
5	Set Brush motor PWM Value - Manual Mode	0006	H → D
6	Set Brush Direction	0007	H → D
7	Set Motor PWM value — Auto mode	0009	H → D
8	Set Brush motor PWM value — Auto mode	000A	H → D
9	Set Auto Schedule Time of Day	000B	H → D
10	Set Sensor Status	000C	H → D
11	Set RTCC Value	000D	H → D
12	Set Device Info	000E	H → D

13	Set Motor Over Current limits	000F	H → D
14	Clear Error Code	0010	H → D
15	Get Battery, PV, SOC values	101C	H ↔ D
16	Get Error Status	1018	H ↔ D
17	Get Device Info	1019	H ↔ D
18	Get Current Mode	1001	H ↔ D
19	Get Manual Control	1003	H ↔ D
20	Get motor PWM Value — Manual Mode	1004	H ↔ D
21	Get Motor Status	1005	H ↔ D
22	Get Brush motor PWM Value — Manual Mode	1006	H ↔ D
23	Get Brush Direction	1007	H ↔ D
24	Get Motor PWM value — Auto mode	1009	H ↔ D
25	Get Brush motor PWM value — Auto mode	100A	H ↔ D
26	Get Auto Schedule Time of Day	100B	H ↔ D
27	Get RTCC Value	100D	H ↔ D
28	Get Sensor Status	100C	H ↔ D
29	Get Current Status	100E	H ↔ D
30	Get Last Operation Status	100F	H ↔ D
31	Get Motor Over Current Limits	1010	H ↔ D
32	Get Motor Current Values	1011	H ↔ D
33	Set Rotational Pulse Count values	0011	H → D
34	Set Low Battery SoC value	0012	H → D
35	Get Rotational Pulse Count values	1014	H ↔ D
36	Get Low battery SoC value	1015	H ↔ D
37	Set Zigbee Configuration	0013	H → D
38	Get Zigbee Configuration	101A	H ↔ D
39	Get Zigbee Network Parameters	101B	H ↔ D
40	Reset Zigbee Network	0014	H → D
41	Get Temperature Values	101D	H ↔ D
42	Set Over Current Fault Conditions	0016	H → D
43	Get Over Current Fault Conditions	101E	H ↔ D
44	Reset to Defaults	0015	H → D
45	Gateway Zigbee Configuration	0201	H → D
46	Get Gateway Zigbee Configuration	1201	H ↔ D
47	Get Gateway Zigbee Network Parameters	1202	H ↔ D

48	Reset Gateway Zigbee Network	0202	H --> D

New Commands

S.NO	OPERATION	COMMAND	DIRECTION
49	Set / Get Interval for Different parameters	0030 / 1030	H → D / H ↔ D
50	Set / Get Wheel diameter in Millimeter	0031 / 1031	H → D / H ↔ D
51	Set / Get no of cycle frequency per day	0032 / 1032	H → D / H ↔ D
52	Set / Get Home Return / No operation States	0033 / 1033	H → D / H ↔ D
53	Set / Get Error Reset Count	0034/1034	H → D / H ↔ D
54	Set/ Get Valid Communication Distance	0035/1035	H --> D / H <--> D
55	Get Log for Specific parameter	103F	H <--> D

Default Communication Sequence

Depending on the command the communication can be initiated by either the device or the host. When the communication is initiated by the host the device will respond back with the following common acknowledge message.

Common Acknowledge Message:

Device acknowledge message to confirm if the preceding message from the host was received and in expected format. This is an acknowledgement of the delivery of the message only and does not imply the successful execution of the command. Acknowledgement frame will follow a response frame if there is a request.

JSON format:

```
"DID": "xxxx",
"CMD": "1111",
"STATUS": "xx"
```

Frame Description:

Parameters	Usage
STATUS	Status contain the error code to indicate if there was an error in the preceding message
	Length = 2 Characters (Number as string) Values = 00 to 99 00 — No error 01 — Parse error 02 — Invalid command

	03 — Invalid data 04 — Data out of range 05 — EEPROM error 06 — No response from device 07 — JSON Error from Gateway 08 — Unknown error
--	--

Communication APIs

Communication APIs used for different operations are described below.

1.1 Set Mode-Auto/Manual Control

To Set the operation mode to be automatic or manual mode.

JSON format:

"DID": "xxxx",

"CMD": "0001",

"VALUES": "<values>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0001", "VALUES": "0"}

Parameters	Usage
VALUES	<values> 0 - Automatic mode 1 - Manual control mode

1.2 Set Manual Control:

Command to control the tracker movement manually.

JSON format:

"DID": "xxxx",

"CMD": "0003",

"VALUES": "<operation>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0001", "VALUES": "1"}

Parameters	Usage
VALUES	<operation> 1— Moves the robot forward 2— Moves the robot backward

	3— Robot does a forward and reverse 4— Robot's speed ramps down and stops 5— Robot stops immediately
--	--

1.3 Set Linear Motor values-Manual Mode:

To Set PWM duty cycle values for motor operation in Manual Mode.

JSON format:

"DID": "xxxx",

"CMD": "0004",

"VALUES": "<accel time>,<decel time>,<accel distance>,<approach start pwm>,<run pwm>,<approach end pwm>,<decel distance>,<zero>,<zero>,<zero>"

Frame Description:

{"DID": "13A20041A7A7D2", "CMD": "0004", "VALUES": "1500,1000,500,65,100,65,500,0,0,0"}

Parameters	Usage
VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Accel distance — Distance for Slow start Approach start pwm — pwm value from Zero start to Run approach Start(0 to 100). Run pwm — Maximum duty cycle (0 to 100) Approach end pwm — pwm value from Run approach end to Zero Stop(0 to 100). Decel Distance— Distance for Slow end

1.4 Set Motor States:

Set Command to Enable/Disable Brush motor and Linear motor.

JSON format:

"DID": "xxxx",

"CMD": "0005",

"VALUES": "<state1>,<state2>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0005", "VALUES": "0,0"}

Parameters	Usage
VALUES	<state1> 1 — Enable brush motor 0 — Disable brush motor <state2>

	1 — Enable linear motor 0 — Disable linear motor
--	---

1.5 Set Brush motor values-Manual Mode:

To set PWM duty cycle values for brush motor operation in Manual Mode.

JSON format:

"DID": "xxxx",

"CMD": "0006",

"VALUES": "<accel time>,<decel time>,<run pwm>,<time Interval>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0006", "VALUES": "1500,1000,100,3"}

Parameters	Usage
VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Run pwm — Maximum duty cycle (0 to 100) time interval — 1 to 1000

1.6 Set Brush motor direction:

Command to control the brush motor direction.

JSON format:

"DID": "xxxx",

"CMD": "0007",

"VALUES": "<direction>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0007", "VALUES": "0"}

Parameters	Usage
VALUES	<direction> 0 — Run brush motor forward 1 — Run brush motor in reverse

1.7 Set Linear motor Values-Auto Mode:

To set PWM duty cycle values for motor operation in Auto Mode.

JSON format:

"DID": "xxxx",

"CMD": "0009",

"VALUES": "<accel time>,<decel time>,<accel distance>,<approach start pwm>,<run pwm>,<approach end pwm>,<decel distance>,<zero>,<zero>,<zero>"

Frame Description:

{"DID": "13A20041A7A7D2", "CMD": "0009", "VALUES": "1500,1000,500,65,100,65,500,0,0,0"}

Parameters	Usage
VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Accel distance — Distance for Slow start Approach start pwm — pwm value from Zero start to Run approach Start(0 to 100). Run pwm — Maximum duty cycle (0 to 100) Approach end pwm — pwm value from Run approach end to Zero Stop(0 to 100). Decel Distance— Distance for Slow end

1.8 Set Brush motor values-Auto Mode:

To set PWM duty cycle values for brush motor operation in Auto Mode.

JSON format:

"DID": "xxxx",

"CMD": "000A",

"VALUES": "<accel time>,<decel time>,<run pwm>,<time Interval>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "000A", "VALUES": "1500,1000,100,3"}

Parameters	Usage
VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Run pwm — Maximum duty cycle (0 to 100) time interval – 1 to 1000

1.9 Set Auto schedule time:

Set time to start auto mode.

JSON format:

"DID": "xxxx",

"CMD": "000B",

"VALUES": "<time(1)>,.....,<time(19)>"

Frame Description:

```
{"DID": "13A20041A7A7D2", "CMD": "000B", "VALUES": "0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000"}
```

Parameters	Usage
VALUES	Time(X) - Time in HHMM format.(X = 19 Schedules maximum)

1.10 Set Sensor states:

Command to Enable/Disable Edge sensors and Proximity sensors for operations.

JSON format:

"DID": "xxxx",

"CMD": "000C",

"VALUES": "<state1>,<state2>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "000C", "VALUES": "0,0"}

Parameters	Usage
VALUES	<state1> 1— Enable Edge sensor 0 — Disable Edge Sensor <state2> 1— Enable Proximity sensor 0 — Disable Proximity Sensor

1.11 Set RTC Value:

Set RTC Date, Month, Year and Time Stamp.

JSON format:

"DID": "xxxx",

"CMD": "000D",

"VALUES": "<Date>,<Month>,<Year>,<Hour>,<Minute>,<Second>,"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "000D", "VALUES": "12,1,2022,14,45,00"}

Parameters	Usage
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VALUES	<Date> - Date to be Set <Month> - Month to be Set <Year> - Year to be Set <Hour> - Limit from 00 to 23 <Minute> - Limit from 00 to 59 <Second> - Limit from 00 to 59
---------------	---

1.12 Set Device Info:

Sets end device details. DID and VALUES will be same if zigbee Address used as end device Info.

JSON format:

"DID": "xxxx",

"CMD": "000E",

"VALUES": "<Device ID>,<Hardware version>,<Serial No>"

Frame Description:

{"DID": "13A20041A7A7D2", "CMD": "000E", "VALUES": "FFFF, 0.1V, SL000"}

Parameters	Usage
VALUES	<Device ID> - Device Identification number <Hardware Version> - Hardware Version <Serial No> - Serial Number Maximum number of characters is 10 for every field

1.13 Set Motor Over Current Limits:

Sets motor over current limits for all three motors .

JSON format:

"DID": "xxxx",

"CMD": "000F",

"VALUES": "<IMOT1>,<IMOT2>,<IMOT3>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "000F", "VALUES": "10,10,10"}

Parameters	Usage
VALUES	<IMOT1> - Over Current limit for motor 1 <IMOT2> - Over Current limit for motor 2 <IMOT3> - Over Current limit for motor 3

1.14 Clear Error Code:

Clears the error codes in the end device .

JSON format:

"DID": "xxxx",

"CMD": "0010"

"VALUES": "<Error Codes>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0010", "VALUES": "FF"}

Parameters	Usage
VALUES	Error Codes — Error Codes to be cleared as a hexadecimal number. (check Annexure 1 for details)

1.15 Get Battery, PV, SOC values:

Get the battery, PV voltages, Currents, State of Charge of the battery and whether the battery is charging or not.

JSON format:

"DID": "xxxx",

"CMD": "101C",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "101C"}

Parameters	Usage
NIL	Nil

Reply:

Send SOC of the battery and state of charger.

"DID": "xxxx",

"CMD": "101C",

"VALUES": "<Vin>,<lin>,<Vbat>,<lbat>,<temp>,<soc>,<chargerstate>,<VBAT>,<VPV>,<IMPPT>,<PWR>,<HS_TEMP>,<EXT_TEMP>,<BAT_STATE>,<LOAD_STATE>,<LOAD_TRIP_CNT>"

Frame Description:

Parameters	Usage
VALUES	Vin — Input Voltage lin — Input Current Vbat — Battery Voltage

	Ibat — Battery Current Temp — Board temperature soc - 0 to 100 SoC of battery charger state - 1 for charging, 0 for not charging Remaining as per Amberroot values
--	--

Disclaimer — SoC value will be invalid when a battery is connected for the first time or if the device is off for a long duration.

1.16 Get Error Status:

Get Error status from the end device.

JSON format:

"DID": "xxxx",

"CMD": "1018",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1018"}

Parameters	Usage
NIL	Nil

Reply:

Send Error status of the end device.

"DID": "xxxx",

"CMD": "1018",

"VALUES": "<value>"

Frame Description:

Parameters	Usage
VALUES	Gives out motor drive and MCU statuses as a 32bit Hex Value. Can be used to identify the type of error.

1.17 Get Device Info:

Get message from host to read end device details.

JSON format:

"DID": "xxxx",

"CMD": "1019",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1019"}

Parameters	Usage
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NIL	Nil
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Reply:

Reply message from device to host with end device details. DID and VALUES will be same if zigbee Address used as end device Info.

"DID": "xxxx",

"CMD": "1019",

"VALUES": "<Device ID>,<Hardware Version>,<Serial No>,<Firmware Version>"

Frame Description:

Parameters	Usage
VALUES	<Device ID> - Device Identification number <Hardware Version> - Hardware Version <Serial No> - Serial Number <Firmware Version> - Firmware version hardcoded in the device

1.18 Get Current mode:

Gets the current mode of the end device.

JSON format:

"DID": "xxxx",

"CMD": "1001"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1001"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1001",

"VALUES": "<Current Mode >"

Frame Description:

Parameters	Usage
VALUES	<Current Mode> - Current Operating Mode. 0 - AUTO 1 - MANUAL

1.19 Get Manual Control:

Get the mode set for manual control.

JSON format:

"DID": "xxxx",

"CMD": "1003"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1003"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1003",

"VALUES": " <operation>"

Frame Description:

Parameters	Usage
VALUES	<operation> 1— Moves the robot forward 2 — Moves the robot backward 3 — Robot does a forward and reverse 4 — Robot's speed ramps down and stops 5 — Robot stops immediately

1.20 Get Linear motor values-Manual mode:

Get PWM duty cycle for robot operation in manual mode.

JSON format:

"DID": "xxxx",

"CMD": "1004",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1004"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1004",

"VALUES": "<accel time>,<decel time>,<accel distance>,<approach start pwm >,<run pwm>,<approach end pwm>,<decel distance>,<accel pulse count>,<decel pulse count>"

Frame Description:

Parameters	Usage
VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Accel distance — Distance for Slow start Approach start pwm — pwm value from Zero start to Run approach Start(0 to 100). Run pwm — Maximum duty cycle (0 to 100) Approach end pwm — pwm value from Run approach end to Zero Stop(0 to 100). Decel Distance— Distance for Slow end accel pulse count - Pulse count for Distance Decel pulse count – pulse count for Distance

1.21 Get Motor States:

Get whether Brush motor and Linear motor is enabled or not.

JSON format:

"DID": "xxxx",

"CMD": "1005",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1005"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1005",

"VALUES": "<state1>,<state2>"

Frame Description:

Parameters	Usage
VALUES	<state1>-Brush motor 1 for enabled state 0 for Disabled state <state2>-Linear motor 1 for enabled state 0 for Disabled state

1.22 Get Brush motor values-Manual mode:

Get PWM duty cycle for brush motor operation in manual mode.

JSON format:

"DID": "xxxx",

"CMD": "1006"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1006"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1006",

"VALUES": "<accel time>,<decel time>,<run pwm>,<time interval>"

Frame Description:

Parameters	Usage
VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Run pwm — Maximum duty cycle (0 to 100) time interval - 1 to 1000

1.23 Get Brush motor Direction:

Get the brush motor direction.

JSON format:

"DID": "xxxx",

"CMD": "1007",

Frame Description: {"DID":"13A20041A7A7D2","CMD":"1007"}

Parameters	Usage
NIL	Nil

Reply:

"DID":"xxxx",

"CMD":"1007",

"VALUES": "<value>"

Frame Description:

Parameters	Usage
VALUES	<Value> 0 - FORWARD 1 - REVERSE.

1.24 Get Linear motor values-Auto mode:

Get PWM duty cycle for robot operation in auto mode.

JSON format:

"DID":"xxxx",

"CMD":"1009",

Frame Description: {"DID":"13A20041A7A7D2","CMD":"1009"}

Parameters	Usage
NIL	Nil

Reply:

"DID":"xxxx",

"CMD":"1009",

"VALUES": "<accel time>,<decel time>,<accel distance>,<approach start pwm>,<run pwm>,<approach end pwm>,<decel distance>,<accel pulse count>,<decel pulse count>"

Frame Description:

Parameters	Usage
------------	-------

VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Accel distance — Distance for Slow start Approach start pwm — pwm value from Zero start to Run approach Start(0 to 100). Run pwm — Maximum duty cycle (0 to 100) Approach end pwm — pwm value from Run approach end to Zero Stop(0 to 100). Decel Distance— Distance for Slow end accel pulse count - Pulse count for Distance Decel pulse count – pulse count for Distance
---------------	---

1.25 Get Brush motor values-Auto mode:

Get PWM duty cycle for brush motor operation in auto mode.

JSON format:

"DID": "xxxx",

"CMD": "100A",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "100A"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "100A",

"VALUES": "<accel time>,<decel time>,<run pwm>,<time interval>"

Frame Description:

Parameters	Usage
VALUES	Accel time — Ramp up time (milliseconds) Decel time — Ramp down time (milliseconds) Run pwm — Maximum duty cycle (0 to 100) dead speed time interval – 1 to 1000

1.26 Get Auto Schedule Time:

Get time set for starting auto.

JSON format:

```
"DID": "xxxx",
"CMD": "100B",
```

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "100B"}

Parameters	Usage
NIL	Nil

Reply:

```
"DID": "xxxx",
"CMD": "100B",
"VALUES": "<time(1)>,.....,<time(19)>"
```

Frame Description:

Parameters	Usage
VALUES	time(X) — Time in HHMM format (X- 19 max limit)

1.27 Get RTC Value:

Get current RTC Date, Month, Year and Time Stamp.

JSON format:

```
"DID": "xxxx",
"CMD": "100D",
```

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "100D"}

Parameters	Usage
NIL	Nil

Reply:

```
"DID": "xxxx",
"CMD": "100D",
"VALUES": "<Date>,<Month>,<Year>,<Hour>,<Minute>,<Second>,"
```

Frame Description:

Parameters	Usage
VALUES	<Date> - Date to be Set <Month> - Month to be Set <Year> - Year to be Set <Hour> - Limit from 00 to 23 <Minute> - Limit from 00 to 60 <Second> - Limit from 00 to 60

1.28 Get Sensor Status:

Get whether Edge sensors / Proximity sensors are enabled or not.

JSON format:

"DID": "xxxx",

"CMD": "100C",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "100C"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "100C",

"VALUES": "<state1>,<state2>"

Frame Description:

Parameters	Usage
VALUES	<State1> 1 - Enabled State 0 - Disabled State <State2> 1 - Enabled State 0 - Disabled State

1.29 Get Current Status:

Get current status of the end device.

JSON format:

"DID": "xxxx",

"CMD": "100E"

Frame Description: {"DID":"13A20041A7A7D2","CMD":"100E"}

Parameters	Usage
NIL	Nil

Reply:

Send current status details of end device.

"DID":"xxxx",

"CMD":"100E",

"VALUES": "<CurrentMode>,<MotorState>,<count1>,<count2>,<Distance>,<RPM>,<EdgesensorStatus1>,<Edge sensor Status2>,<Proximity sensor Status1>,<Proximity sensor Status2>,<Cycle Completed>,<Cycle Pending>,<Cumulative_Distance>"

Frame Description:

Parameters	Usage
VALUES	<p><Current Mode> - Current Operating Mode, 0 for auto or 1 for manual</p> <p><Motor State> - 1 for forward, 2 for reverse, 3 for stop</p> <p><count1>— Current pulse count of sensor 1</p> <p><count2> — Current pulse count of sensor 2</p> <p><Distance> - Distance of linear motor</p> <p><RPM> - RPM of Brush Motor</p> <p><Edge sensor status1> — Current state of edge sensor</p> <p><Edge sensor status2> Current state of edge sensor</p> <p><Proximity sensor status1> — Current state of Proximity sensor</p> <p><Proximity sensor status2> - Current state of Proximity sensor</p> <p><Cycle completed> - Completed cycle count</p> <p><Cycle pending> - Pending cycle count</p> <p><Cumulative_Distance> - Total distance covered by cleaner in one row.</p>

1.30 Get Last Operation Status:

Get the status of the previously completed cycle. Robot state from start to stop is considered as an operation, irrespective of the operating mode.

JSON format:

"DID":"xxxx",

"CMD":"100F",

Frame Description: {"DID":"13A20041A7A7D2","CMD":"100F"}

Parameters	Usage
NIL	Nil

Reply:

Send last cycle details of end device.

"DID": "xxxx",

"CMD": "100F",

"VALUES": "<Mode>,<Cycle number>,<Error_Code>,<Distance>,<Direction>,<Cycle start time>,<Cycle start SOC>,<Cycle end time>,<Cycle end soc>,<Total Error reset Count>,<Cumulative_Distance>"

Frame Description:

Parameters	Usage
VALUES	<Mode> - Operation mode 0 for Auto ,1 for manually <Cycle number> - Current cycle number <Error_Code> - Pulse count of the sensor <Distance> - Distance traveled by the robot <Direction> - Direction of the robot traveling <Cycle start time> - Start time of current cycle in IST time format <Cycle start soc> - State of charge at start of current cycle(%) <Cycle end time> - End time of current cycle in IST time format <Cycle end soc> - state of charge at end of current cycle(%) <Total error reset count> - Total no of reset count on current Cycle <Cumulative_Distance> - Total distance covered by the cleaner in one row

1.31 Get Motor Over Current Limits:

Get the motor over current limit values set.

JSON format:

"DID": "xxxx",

"CMD": "1010",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1010"}

Parameters	Usage
NIL	Nil

Reply:

Send motor over current limit values.

"DID": "xxxx",

"CMD": "1010",

"VALUES": "<IMOT1>,<IMOT2>,<IMOT3>"

Frame Description:

Parameters	Usage
VALUES	<IMOT1> - Motor 1 over current limit <IMOT2> - Motor 2 over current limit <IMOT3> - Motor 3 over current limit

1.32 Get Motor Current:

Get the motor current at that instance.

JSON format:

"DID": "xxxx",

"CMD": "1011",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1011"}

Parameters	Usage
NIL	Nil

Reply:

Send motor currents.

"DID": "xxxx",

"CMD": "1011",

"VALUES": "<IMOT1>,<IMOT2>,<IMOT3>"

Frame Description:

Parameters	Usage
VALUES	<IMOT1> - Motor Current 1 at that instance <IMOT2> - Motor Current 2 at that instance <IMOT3> - Motor Current 3 at that instance

1.33 Set Rotational Distance values:

To set rotational Distance values for forward and reverse movement in meter.

JSON format:

"DID": "xxxx",

"CMD": "0011",

"VALUES": "<Forward distance>,<Reverse distance>,<zero>,<zero>,<zero>,<zero>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0011", "VALUES": "5000,5000,0,0,0,0"}

Parameters	Usage
VALUES	Forward distance — forward rotational distance in meter Reverse distance — reverse rotational distance in meter

1.34 Set Low battery SOC value:

To set SoC value which is considered as low battery.

JSON format:

"DID": "xxxx",

"CMD": "0012",

"VALUES": "SoC"

Frame Description:

{"DID": "13A20041A7A7D2", "CMD": "0012", "VALUES": "0"}

Parameters	Usage
VALUES	SoC — value which the device considers as low battery.(0 to 100)

Disclaimer — SoC value will be invalid when a battery is connected for the first time or if the device is off for a long duration.

1.35 Get Rotational Distance values:

Get the rotational Distance values for forward and reverse movement in meter.

JSON format:

"DID": "xxxx",

"CMD": "1014",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1014"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1014",

"VALUES": "<Forward distance>,<Reverse distance>,<forward pulse count>,<Reverse pulse count>"

Frame Description:

Parameters	Usage
VALUES	Forward distance — forward rotational distance in meter Reverse distance — reverse rotational distance in meter Forward pulse count — pulse count Reverse pulse count — pulse count

1.36 Get Low battery SOC Values:

Get the low battery SoC value.

JSON format:

"DID": "xxxx",

"CMD": "1015",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1015"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1015",

"VALUES": "SoC"

Frame Description:

Parameters	Usage
VALUES	SoC — SoC value which is considered as low battery

1.37 Set ZigBee Configuration:

Message for Zigbee and network parameter configurations of end device. All values are Hexadecimal Characters. These values are passed to Zigbee and are not stored in microcontroller. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx",

"CMD": "0013",

"VALUES": "<PANID >, <LNKKEY>, <ENC_OPTIONS>, <ENC_ENABLE>,"

<JV_ENABLE>,<WRITE_ENABLE>"

Frame Description:

{"DID": "13A20041A7A7D2", "CMD": "0013", "VALUES": "00000002, 002, FF, 0, 0, 0"}

Parameters	Usage
VALUES	PANID — Network PAN ID -> "ID" (1 to 16 Hexadecimal Characters) LNKKEY — Encryption Link key -> "KY" (1 to 32 Hexadecimal Characters) ENC_OPTIONS — Encryption Options -> "EO" (Hex Chars 0 to" FF) ENC_ENABLE — Encryption Enable -> "EE" (0 or 1) JV_ENABLE — Join Verify Enable -> "JV" (0 or 1) WRITE_ENABLE — Write Config to Store Settings -> "WR" (0 or 1)

1.38 Get ZigBee Configuration:

Gets the Configuration information of the Zigbee module in end device. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx",

"CMD": "101A"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "101A"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "101A",

"VALUES": "<ASSOC_IND>, <CONF_PAN_ID>,<ENC_OPTIONS>,"

<ENC_ENABLE>,<JV_ENABLE>"

Frame Description:

These Parameters are read from the Zigbee Module and are not available in microcontroller. The value is empty if unable to read from Zigbee.

Parameters	Usage
------------	-------

VALUES	ASSOC IND — Association Indication -> "AI" (Hex Chars 00 to FF) CONF_PAN_ID - Configured Pan ID -> "ID" (16 byte Hex Characters) ENC OPTIONS - Encryption Options -> "EO" (Hex Chars 00 to FF) ENC ENABLE — Encryption Enable -> "EE" (0 or 1) JV ENABLE — Join Verify Enable -> "JV" (0 or 1)
---------------	--

1.39 Get ZigBee Network Parameters:

Gets the network information of the Zigbee module in end device. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx",

"CMD": "101B"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "101B"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "101B", "VALUES": "<OP_PAN_ID>, <OP_PAN_ID_16BIT>, <OP_CHANNEL>, <STACK_PROFILE>"

Frame Description:

These Parameters are read from the Zigbee Module and are not available in microcontroller. The value is empty if unable to read from Zigbee.

Parameters	Usage
VALUES	OP_PAN_ID - Operating Pan ID -> "OP" (16 byte Hex Characters) OP PAN ID 16BIT - 16 bit Operating Pan ID -> "OI" (2 byte Hex Characters) OP CHANNEL — Operating Channel -> "CH" (Hex Chars 00 to FF) STACK_PROFILE— Zigbee Stack Profile -> "ZS" (Hex Chars 00 to FF)

1.40 Reset ZigBee Network:

Resets the ZigBee network of end device. It's advisable to have minimum or no communication in the network for some time after the issue of global reset command for it to effectively pass to all devices in the network. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx",

"CMD": "0014" "VALUES": "<RESET_MODE>"

Frame Description:

{"DID": "13A20041A7A7D2", "CMD": "0014", "VALUES": "0"}

Parameters	Usage
VALUES	RESET_MODE — Its 0 or 1. For Local Reset the value is 0 and for global reset the value is 1

1.41 Get Temperature Sensor Values:

Get the temperature sensor at that instance.

JSON format:

"DID": "xxxx",

"CMD": "101D",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "101D"}

Parameters	Usage
NIL	Nil

Reply:

Send temperature values.

"DID": "xxxx",

"CMD": "101D",

"VALUES": "<time Stamp>,<temp1>,<temp2>,<temp3>"

Frame Description:

Parameters	Usage
VALUES	<time stamp> - Time stamp with date and time <temp1> - Temperature around battery charger <temp2> - Temperature around motor drives <temp3> - Internal board temperature

1.42 Set Over Current Fault Conditions:

Set the maximum motor current noise time.

JSON format:

"DID": "xxxx"

"CMD": "0016"

"VALUES": "<motor current noise time>", "<maxIloadFreqTimeValue>", "<maxIloadRepeatCountValue>",
 "<motorPauseDelay>"

Frame Description:

```
{"DID": "13A20041A7A7D2", "CMD": "0016", "VALUES": "500,0,0,0"}
```

Parameters	Usage
VALUES	<motor current noise time> - Time in milliseconds above which it is considered as valid overcurrent and not as a spike/noise. Rest of the values should be left empty

1.43 Get Over Current Fault Conditions:

Get the maximum motor current noise time.

JSON format:

"DID": "xxxx",

"CMD": "101E",

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "101E"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "101E",

"VALUES ": "<Motor Current Noise time>,< Motor Pause time >,<Repeat Count>,<Repeat Time>"

Frame Description:

Parameters	Usage
VALUES	<Motor Current Noise time> - Time in milliseconds above which it is considered as valid overcurrent and not as a spike/noise <Motor Pause time> - Time in milliseconds to pause the motor if valid overcurrent is detected <Repeat Count> - Maximum No. of times to pause the motor before which over current fault is set <Repeat Time> - Maximum time in milliseconds between two successive over current detections. This value should be greater than the pause time

1.44 Reset to defaults:

Resets all stored variables to default values. This resets all data stored in Device EEPROM to Defaults.

JSON format:

"DID": "xxxx",

"CMD": "0015"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1015"}

Parameters	Usage
NIL	Nil

1.45 Gateway ZigBee Configuration:

Message to configure Zigbee and network parameter configurations of Zigbee module in gateway. All values are Hexadecimal Characters. These values are passed to Zigbee and are not stored in microcontroller. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx",

"CMD": "0201",

"VALUES": "<PANID >, <LNKKEY>, <ENC_OPTIONS>, <ENC_ENABLE>, <WRITE_ENABLE>"

Frame Description:

Parameters	Usage
VALUES	PANID — Network PAN ID -> "ID" (1 to 16 Hexadecimal Characters) LNKKEY — Encryption Link key -> "KY" (1 to 32 Hexadecimal Characters) ENC_OPTIONS — Encryption Options -> "EO" (Hex Chars 0 to FF) ENC_ENABLE — Encryption Enable -> "EE" (0 or 1) WRITE_ENABLE — Write Config to Store Settings -> "WR" (0 or 1)

1.46 Get Gateway ZigBee Configuration:

Gets the Configuration information of the Zigbee module in gateway. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx",

"CMD": "1201"

Frame Description:

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1201",

"VALUES": "<CONF_PAN_ID>, <ENC_OPTIONS>, <ENC_ENABLE>"

Frame Description:

These Parameters are read from the Zigbee Module and are not available in microcontroller. The value is empty if unable to read from Zigbee.

Parameters	Usage
VALUES	CONF_PAN_ID - Configured Pan ID -> "ID" (16 byte Hex Characters) ENC OPTIONS - Encryption Options -> "EO" (Hex Chars 00 to FF) ENC ENABLE — Encryption Enable -> "EE" (0 or 1)

1.47 Get Gateway ZigBee Network Parameters:

Gets the network information of the Zigbee module in gateway. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx",

"CMD": "1202"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1202"}

Parameters	Usage
NIL	Nil

Reply:

"DID": "xxxx",

"CMD": "1202",

"VALUES": "<OP_PAN_ID>, <OP_PAN_ID_16BIT>, <OP_CHANNEL>,
<STACK_PROFILE>"

Frame Description:

These Parameters are read from the Zigbee Module and are not available in microcontroller. The value is empty if unable to read from Zigbee.

Parameters	Usage
VALUES	OP PAN ID - Operating Pan ID -> "OP" (16 byte Hex Characters) OP_PAN_ID_16BIT - 16 bit Operating Pan ID -> "OI" (2 byte Hex Characters) OP_CHANNEL — Operating Channel -> "CH" (Hex Chars 00 to FF)

STACK_PROFILE— Zigbee Stack Profile -> "ZS" (Hex Chars 00 to FF)
--

1.48 Reset Gateway ZigBee Network:

Resets the ZigBee network of gateway. It's advisable to have minimum or no communication in the network for some time after the issue of global reset command for it to effectively pass to all devices in the network. Care should be taken when executing Zigbee related commands as it may affect normal data communication.

JSON format:

"DID": "xxxx"

"CMD": "0202"

"VALUES": "<RESET_MODE>"

Frame Description:

Parameters	Usage
VALUES	RESET_MODE Local Reset the value is 0 Global reset the value is 1.

1.49 Set / Get Interval for different parameters:

Set the value of intervals for Different parameters.

JSON format:

"DID": "xxxx",

"CMD": "0030"

"VALUES": "<I1>,<P1>,<I2>,<P2>,<I3>,<P3>,<I4>,<P4>,<I5>,<P5>,<I6>,<P6>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0030", "VALUES": "1,1,1,2,1,3,1,4,1,5,1,6"}

Parameters	Usage
VALUES	IX - <interval> - Interval for recording data 0 - 60 from 1 minute to 60 minute PX - <parameter> - parameter to define log types 1 – Temperature with respect to date and time 2 – State of charge with respect to date and time 3 – Motor current with respect to distance and time 4 – Daily log for no of cycles data 5 – Error log with respect to date and time 6 – Free Parameter

Get the value of intervals for Different parameters.

JSON format:

"DID": "xxxx",

"CMD": "1030"

Reply:

"DID": "xxxx",

"CMD": "1030"

"VALUES": "<I1>,<P1>,<I2>,<P2>,<I3>,<P3>,<I4>,<P4>,<I5>,<P5>,<I6>,<P6>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1030"}

Parameters	Usage
VALUES	IX - <interval> - Interval for recording data 0 - 60 from 1 minute to 60 minute PX - <parameter> - parameter to define log types 1 – Temperature with respect to date and time 2 – State of charge with respect to date and time 3 – Motor current with respect to distance and time 4 – Daily log for no of cycles data 5 – Error log with respect to date and time 6 – Free Parameter

1.50 Set / Get wheel Diameter:

Set wheel Diameter:

Set the value of Wheel size in Diameter to calculate Distance travelled by the solar cleaner.

JSON format:

"DID": "xxxx",

"CMD": "0031"

"VALUES": "<Diameter>,<Pulse>,<dead Speed>,<zero>,<Zero>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0031", "VALUES": "150,2,55,0,0"}

Parameters	Usage
VALUES	<Diameter>-Diameter in Millimeter (mm)

	<Pulse> - Pulse value for Distance calculation (1-4) <dead speed> – Speed at end of pulse count (55/65/75)
--	---

Get wheel Diameter:

JSON format:

"DID": "xxxx",

"CMD": "1031"

Reply:

"DID": "xxxx",

"CMD": "1031"

"VALUES": "<Diameter>,<Pulse>,<dead speed>,<rotation Time>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1031"}

Parameters	Usage
VALUES	<Diameter>-Diameter in Millimeter (mm) <Pulse> - Pulse value for Distance calculation <dead speed> – Speed at end of pulse count (55/65/75) <rotation time> – rotation time at end(15/5/2 Seconds)

1.51 Set / Get no of Cycle per day:

Set no of cycles frequency per day:

JSON format:

"DID": "xxxx",

"CMD": "0032"

"VALUES": "<values>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0032", "VALUES": "5"}

Parameters	Usage
VALUES	No of cycle frequency per day

Get no of cycles per day:

JSON format:

"DID": "xxxx",

"CMD": "1032"

Reply:

"DID": "xxxx",

"CMD": "1032"

"VALUES": "<values>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1032"}

Parameters	Usage
VALUES	No of cycle frequency per day

1.52 Set / Get Home Return / No Operation States:

Set states such as home return, regular run or no operation.

JSON format:

"DID": "xxxx"

"CMD": "0033"

"VALUES": "<States>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0033", "VALUES": "0"}

Parameters	Usage
VALUES	<States> - States after errors 0 – Regular Run 1 – Home Return 2 – No operation

Get states after errors

JSON format:

"DID": "xxxx"

"CMD": "1033"

Reply:

"DID": "xxxx",

"CMD": "1033"

"VALUES": "<States>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1033"}

Parameters	Usage
VALUES	<States> - States after errors 0 – Regular Run 1 – Home Return 2 – No operation

1.53 Set / Get Error Reset Count:

Set states from same position for remaining distance and auto reset, auto restart count for Continue process.

JSON format:

"DID": "xxxx"

"CMD": "1034"

"VALUES": "<reset count>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0034", "VALUES": "5"}

Parameters	Usage
VALUES	<Reset count> - Reset and Restart count to be set (1-10)

Get auto restart Count

JSON format:

"DID": "xxxx"

"CMD": "1034"

Reply:

"DID": "xxxx",

"CMD": "1034"

"VALUES": "<reset count>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1034"}

Parameters	Usage
VALUES	<Reset count> - Reset and Restart count

1.54 Set / Get Valid Communication error distance(with track changer):

Set Communication distance required between track changer and cleaner. Track changer and cleaner

JSON format:

"DID": "xxxx"

"CMD": "0035"

"VALUES": "<distance>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "0035", "VALUES": "1000"}

Parameters	Usage
VALUES	<distance> - distance in millimeters

JSON format:

"DID": "xxxx"

"CMD": "1035"

Reply:

"DID": "xxxx",

"CMD": "1035"

"VALUES": "<distance>, <pulse_count>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "1035"}

Parameters	Usage
VALUES	<distance> - distance in millimeters <pulse_count> - calculated pulse count value

1.55 Get log for Specific parameter:

Get the Log for Different parameters.

JSON format:

"DID": "xxxx",

"CMD": "103F"

"VALUES": "<Parameter>"

Frame Description: {"DID": "13A20041A7A7D2", "CMD": "103F", "VALUES": "1"}

Parameters	Usage
VALUES	PX - <parameter> - parameter to define log types 1 - Temperature with respect to date and time

	2 – State of charge with respect to date and time
	3 – Motor current with respect to distance and time
	4 – Daily log for no of cycles data
	5 – Error log with respect to date and time
	6 – Erase all existing files and create new file to write

Reply:

"DID": "xxxx",

"CMD": "103F"

"VALUES": "<values>"

Frame Description:

Parameters	Usage
VALUES	<values> - Log for the Specific parameter with Timestamp for Set interval

EXAMPLES FOR LOG DATA**1.Temperature LOG:**

FORMAT: #<Date & Time>#, <Battery Temperature>, <Drive Temperature>, <Die Temperature>

EXAMPLE: #02-02-2022 18:15:17#,40.00,40.00,34.78

2.SOC LOG:

FORMAT: #<Date & Time>#, <Input Voltage>, <Input Current>, <Battery Voltage>, <Battery Current>, <Die Temperature>, <SOC Percentage>, <Charging State>,<VBAT>,<VPV>,<IMPPT>,<PWR>,<HS_TEMP>,<EXT_TEMP>,<BAT_STATE>,<LOAD_STATE>,<LOAD_TRIP_CNT>

EXAMPLE: #03-02-2022 18:01:57#,0.0,0.0,26.5,-
0.0,36.9,73.27,0,11.97,8.68,0.03,0.40,29.00,65521.00,67,2,0

3.Motor current LOG:

FORMAT: #<Date & Time>#, <Cycle number>, <Direction>, <Motor1 Current>, <Motor2 Current>, <Motor3 Current>, <Pulse Count>, <Distance>

EXAMPLE: #03-02-2022 09:31:44#2,0,-0.48,2.24,-0.67,0,0

4.Cycle LOG:

FORMAT: #<Date & Time>#, <Cycle number>, <Pulse count>, <Distance>, <Direction>, <Start time>, <Start SOC>, <End time>,<End SOC>,<Restart count>,<Cumulative_Distance>

EXAMPLE: #04-02-2022 17:57:42#,0,28,6580,0,04-02-2022 17:57:28,67.89,04-02-2022 17:57:41,67.88,0

<Cycle_Start_Time>,<Cycle_End_Time> ,<Total_Distance_in_a_row>

5.Error LOG:

FORMAT: #<Date & Time>#, <Mode>, <Direction>, <Cycle number>, <Pulse count>, <Distance>,<Error_code>,<Reset_Error>

EXAMPLE: #05-02-2022 10:38:33#,1,2,0,0,0,0,1 (Reset occurred)

#05-02-2022 10:38:33#,1,2,0,0,0,0,0 (No Reset)

NOTES: Initially SET the below Parameters for Correct working of the Cleaner

*Wheel Diameter and Distance are mentioned in Millimetre

*Set the Wheel Diameter in mm

*Set the Rotational Distance in mm

*Set the Manual / Auto Mode parameters of Linear Motor

*Set the Manual / Auto Mode parameters of Brush Motor

Zeros are Required as Mentioned

Annexure 1: Combined Error Code

This combined Error code(hex) is used in all messages originating from device that contains the STATUS as response value.

D31																												D0			
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-

D1 — Over current fault — Motor 1.

D2 — Over current fault — Motor 2.

D3 — Over current fault — Motor 3.

D4 — Minimum Battery Voltage fault.

D5 — Over Board temperature fault.

D6 — Battery fault.

D7 — Zigbee fault.

D8 — RTC fault.

D9 — Unknown fault.

D11 — Communication Error

If x is 1 the error has occurred.

TC & CLEANER RUNNING Error

Error Code (Hex format)	Description	
2	Over current fault motor -1	D1
4	Over current fault motor -2	D2
8	Over current fault motor -3	D3
10	Minimum battery voltage fault	D4
20	Over Board temperature fault	D5
40	Battery fault	D6
80	Zigbee fault	D7
100	RTC fault	D8
800	Communication fault	D11
10000	Invalid data	
20000	Missed rows	
40000	Invalid distance travelled	
80000	position unknown	
100000	communication error	
200000	cleaner not in position	
400000	cleaner error	
800000	cleaner stall	
1000000	track changer stall	
2000000	TC not in position	
40000000	RFID not matched	
80000000	Invalid row data	

TC error

Cleaner error

Error can occur in both