

CEL-712 Microdust Pro Communication Protocol

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1. Introduction

This document details a communication protocol for the CEL-712 Microdust Pro instrument, implemented primarily to support communication with existing applications (currently interfacing to the original Microdust Pro) but to include several new commands to better integrate the downloading process with Insight.

For the CEL-712, existing commands with additions are used to identify the instrument with actual downloading accomplished using file transfer from the USB MSD drive.

At a later date this protocol will be dropped in favour of the new generic Casella Communication Protocol.

2. Notes

- 2.1.1.1. In this document, **compulsory** space characters are denoted by the ▽ symbol.
- 2.1.1.2. Regular spaces inserted into the printed examples are for clarity only.
- 2.1.1.3. Carriage Return/Line feed pair denoted by CRLF.
- 2.1.1.4. Concentration values are preceded by a space (0x20) or minus (0x2D) character.
- 2.1.1.5. For the measurement range 0-2500 concentration values are expressed as a whole integer value and do not contain a decimal point or any decimal places.

3. Basic Commands (Supported by CEL-712 and Original Microdust Pro)

Only a limited sub-set of the original Microdust communication protocol will be supported by the new CEL-712 instruments. These are:

3.1. Re-initialise instrument (R)

- 3.1.1.1. On receipt of the single ASCII character **R** (0x52) the instrument will reply with a single character **D** (0x44). The instrument will then wait for at least 4000ms to receive a single line of data which it then uses to re-initialise itself with.
- 3.1.1.2. In addition the instrument stops any current logging activity and erases all recorded data.

ID line 1

Zero to 10 ASCII characters belonging to the following set (0x20, 0x30-0x39, 0x41-0x5A, 0x61-0x7A) (SPACE, 0-9, A-Z, a-z) followed by a comma character.

ID line 2

Zero to 16 ASCII characters belonging to the following set (0x20, 0x30-0x39, 0x41-0x5A, 0x61-0x7A) (SPACE, 0-9, A-Z, a-z) followed by a comma character.

Country code

Single ASCII character K (0x4B) (currently only UK is supported) followed by a comma character.

Date/Time

14 ASCII characters **DD/MM/YY, HH:MM** denoting (omit quotes) the date and time to set within the instrument followed by the CRLF sequence.

3.1.2. Example

3.1.2.1. Casella, Measurement, K, 27/02/13, 09:30 CRLF

3.2. Read instrument status (I)

3.2.1.1. On receipt of the single ASCII character I (0x49), the instrument responds with a single line of data, containing the current status of the instrument.

3.2.1.2. The line of data is composed of 5 sections (comma delimited) terminated by the CRLF sequence:

ID line 1

Zero to 10 ASCII characters (0x20, 0x30-0x39, 0x41-0x5A, 0x61-0x7A) (SPACE, 0-9, A-Z, a-z) followed by a comma character.

ID line 2

Zero to 16 ASCII characters (0x20, 0x30-0x39, 0x41-0x5A, 0x61-0x7A) (SPACE, 0-9, A-Z, a-z) followed by a comma character.

Country code

Single ASCII character K (0x4B) (currently only UK is supported) followed by a comma character.

Run Count

Decimal integer value denoting the number of results currently stored within the instrument (value is prefixed with a space character) followed by a comma character.

Firmware ID

13 ASCII characters denoting the current ID for the installed firmware (for example: **80-206017A-02**) followed by comma character.

3.2.2. Example

3.2.2.1. Casella, Measurement, K, 35, 80-206017A-02 CRLF

3.3. Start real time transmission (X)

3.3.1.1. On receipt of the single ASCII character X (0x58) the instrument begins transmitting current concentration values at a rate of approximately one per second.

3.3.1.2. Each concentration value is on a separate line terminated with CRLF sequence.

3.3.1.3. Values are always transmitted as **mg/m3**.

3.4. Stop real time transmission (Z)

3.4.1.1. On receipt of the single ASCII character Z (0x5A) the instrument stops transmitting current concentration values.

4. Original Microdust Pro Commands (Not Supported by CEL-712)

The following commands from the original Microdust Pro protocol will not be supported by the new CEL-712 instruments:

4.1. Download data (T)

- 4.1.1.1. On receipt of the single ASCII character **T** (0x54) the Microdust Pro responds with zero or more lines of recorded data (zero denotes no data currently available) terminated with a single empty line (just CRLF sequence).
- 4.1.1.2. Data transmitted in response to this command is a mixture of two distinct formats, one for cumulative records and one for period records.
- 4.1.1.3. All results are transmitted in reverse time sequence (most recent result transmitted first).
- 4.1.1.4. For each result the download sequence starts with a cumulative record followed by the period records in reverse time sequence (most recent record first).
- 4.1.1.5. Each record (cumulative or period) is appended with an increasing line number, this number begins at zero and increments for each line transmitted.
- 4.1.1.6. This number is (automatically) reset to zero at the beginning of each download request.

4.1.2. Cumulative record

These records contain the following fields:

Line identification

- 4.1.2.1. String literal **Log close** followed by a comma character.

Result end timestamp

- 4.1.2.2. Date and time encoded as **DD/MM/YY, HH:MM** followed by a comma character.

Average concentration

- 4.1.2.3. Average concentration measured over the entire result duration followed by a comma character.

Maximum concentration

- 4.1.2.4. Maximum concentration measured over the entire result duration followed by a comma character.

Maximum concentration timestamp

- 4.1.2.5. Date and time corresponding to the maximum concentration recorded, encoded as **DD/MM/YY, HH:MM** followed by a comma character.

Line number

- 4.1.2.6. Integer line number followed by CRLF sequence.

4.1.3. Period record

These records contain the following fields:

Result timestamp

4.1.3.1. Date and time encoded as **DD/MM/YY, HH:MM** followed by a comma character.

Average concentration

4.1.3.2. Average concentration measured over the period followed by a comma character.

Line number

4.1.3.3. Integer line number followed by CRLF sequence.

4.1.4. Example

4.1.4.1. The following details the download of all data from a Microdust Pro, consisting of 2 separate runs, one of 4 period points and another of 3 period points:

Log close, 18/12/15, 16:34:41, 0.001, 0.003,18/12/15, 16:34:07, 0 CRLF

18/12/15, 16:34:41, 0.002, 1 CRLF

18/12/15, 16:34:40, 0.001, 2 CRLF

18/12/15, 16:34:39, 0.001, 3 CRLF

18/12/15, 16:34:38, 0.002, 4 CRLF

Log close, 18/12/15, 16:33:25, 0.001, 0.004,18/12/15, 16:32:41, 5 CRLF

18/12/15, 16:33:25, 0.001, 6 CRLF

18/12/15, 16:33:24, 0.001, 7 CRLF

18/12/15, 16:33:23, 0.002, 8 CRLF

CRLF

4.2. Set bitmap (B)

4.2.1.1. On receipt of the single ASCII character **B** (0x42) the Microdust Pro will expect to receive a further 1024 bytes of data. This it interprets as a custom monochrome bitmap which is displayed each time the instrument is switched on (until disabled using the Clear bitmap (C) command).

4.3. Clear bitmap (C)

4.3.1.1. On receipt of the single ASCII character **C** (0x43) the Microdust Pro disables the custom bitmap display option. From this point on the instrument will switch on without showing any custom bitmap.

4.3.1.2. To re-instate the custom bitmap display a suitable bitmap must be re-sent to the instrument using the Set bitmap (B) command.

4.4. Mimic keypad exit key (9)

4.4.1.1. On receipt of the single ASCII character **9** (0x39) the Microdust Pro interprets this as if the user had pressed the exit key on the keypad.

4.5. Mimic keypad down key (2)

4.5.1.1. On receipt of the single ASCII character **2** (0x32) the Microdust Pro interprets this as if the user had pressed the down key on the keypad.

4.6. Mimic keypad up key (8)

4.6.1.1. On receipt of the single ASCII character **8** (0x38) the Microdust Pro interprets this as if the user had pressed the up key on the keypad.

4.7. Mimic keypad left key (4)

4.7.1.1. On receipt of the a single ASCII character **4** (0x34) the Microdust Pro interprets this as if the user had pressed the left key on the keypad.

4.8. Mimic keypad right key (6)

4.8.1.1. On receipt of the single ASCII character **6** (0x36) the Microdust Pro interprets this as if the user had pressed the right key on the keypad.

4.9. Mimic keypad enter key (CR)

4.9.1.1. On receipt of the single ASCII character **CR** (0x0D) the Microdust Pro interprets this as if the user had pressed the enter key on the keypad.

4.10. Read screen buffer (i)

4.10.1.1. On receipt of the single ASCII character **i** (0x69) the Microdust Pro replies with a block of 1024 bytes representing the current screen displayed on the instrument's LCD.

5. New Commands (CEL-712 Only)

These commands have been added to the CEL-712 instrument in order to facilitate automatic production (test) procedures and to assist in automating the download process for these new instruments (in insight) whilst still maintaining compatibility with existing Microdust Pro instruments, for whom automatic identification is not possible.

5.1.1.1. All commands are terminated with a CRLF sequence.

5.1.1.2. All responses are terminated with a CRLF sequence.

5.1.1.3. **Get** type command requests expect the instrument to return current state of the requested setting.

5.1.1.4. **Set** type command requests expect no response from the instrument. To test if the required change has been made the corresponding **Get** command can be sent to determine the current (updated) value.

5.1.1.5. Other added commands (especially **set** commands) may interfere with the operation of original Microdust Pro instruments. Numeric values included in the command body may be interpreted as key codes and cause unintentional behaviour.

5.2. Display averaging interval (D)

5.2.1. Get command

D

Instrument returns current display average interval, specified in seconds.

5.2.2. Set command

D=60

Instrument updates display average interval with supplied value, specified in seconds.

5.3. Measurement range (G)

In addition to setting the instrument to a specified measurement range, this command also allows the instrument to be set into an auto-ranging mode.

5.3.1. Get command

G

Instrument returns current measurement range setting:

2.5, mg/m³

25, mg/m³

250, mg/m³

2500, mg/m³

25, g/m³

250, g/m³

AUTO

5.3.2. Set command

G=2.5, mg/m³

Instrument updates measurement range setting with supplied value, permissible settings are:

2.5, mg/m³

25, mg/m³

250, mg/m³

2500, mg/m³

25, g/m³

250, g/m³

AUTO

5.4. Instrument scale factor (F)

5.4.1. Get command

F

Instrument returns the current scale factor setting.

5.4.2. Set command

F=1.01

Instrument updates scale factor setting with supplied value.

5.5. Instrument zero (O) (Letter O, not numeric zero)

5.5.1. Get command

O

Instrument returns the current zero offset setting as a floating point number (value may be negative).

5.5.2. Set command

O=0.01

Instrument updates zero offset setting with supplied value (supplied value may be negative).

5.6. Instrument filter value (L)

5.6.1. Get command

L

Instrument returns the current calibration filter setting.

5.6.2. Set command

L=125.5

Instrument updates calibration filter setting with supplied value.

5.7. Dust type (U)

5.7.1. Get command

U

Instrument returns current selected dust setting (integer value 0 to 4 inclusive), where:

0 Default dust type (scale factor always x1.0)

1 User dust type 1 (scale factor variable)

2 User dust type 2 (ditto)

3 User dust type 3 (ditto)

4 User dust type 4 (ditto)

5.7.2. Set command

U=0

Instrument updates current selected dust setting with supplied value, permissible settings are:

Integer value **0** to **4** inclusive.

5.8. Extra status (E)

5.8.1.1. This command is request only any set type command will be ignored.

5.8.2. Get command

E

Instrument returns extra status information, as comma separated values:

PROBE_STATUS, LOGGER_STATUS

Where **PROBE_STATUS** is:

CLEAN Zero offset within non-contaminated limit

CONTAMINATED Zero offset greater than permitted contaminated limit

Where **LOGGER_STATUS** is:

OFF Logging is currently not logging

ON Logging is currently active

6. CEL-712 - Online Command

This command has been added to support use of the CEL-712 instrument within a MAM installation.

6.1. Request data (<D(?)>)

6.1.1. Command

<D(?)CRC>CRLF

Where:

D Literal: Data command

? Literal: Request

CRC Value: Optional 4-digit (hexadecimal) cyclic-redundancy-check
(Not currently implemented by CEL-712)

CRLF End of line marker (carriage return/line feed pair)

All other characters should be included in the message as shown.

6.1.2. Response

<DATA(YYYY-MM-DD, HH:MM:SS, INST, NNN, 10S, NNN, 1M, NNN, 5M, NNN, 15M, NNN, 30M, NNN, 1H, NNN, TWA, NNN, SPAN, NNN, ZERO, NNN, FACT, NNN)CRC>CRLF

Where:

DATA	Literal: Data record
YYYY	Value: Year (4-digit)
MM	Value: Month (2-digit)
DD	Value: Day of the month (2-digit)
HH	Value: Hours (2-digit, 24-hour format)
MM	Value: Minutes (2-digit)
SS	Value: Seconds (2-digits)
INST	Literal: Instantaneous reading
NNN	Value: Instantaneous reading
10S	Literal: 10 second rolling average
NNN	Value
1M	Literal: 1 minute rolling average
NNN	Value
5M	Literal: 5 minute rolling average
NNN	Value
15M	Literal: 15 minute rolling average
NNN	Value
30M	Literal: 30 minute rolling average
NNN	Value
1H	Literal: 1 hour rolling average
NNN	Value
TWA	Literal: Time weighted average (accumulated average since last reset)
NNN	Value
SPAN	Literal: Current instrument span factor
NNN	Value
ZERO	Literal: Current instrument zero offset
NNN	Value
FACT	Literal: Current instrument dust factor

NNN	Value: Limited to between 0.4 and 10.0 (inclusive)
CRC	Value: Optional 4-digit (hexadecimal) cyclic-redundancy-check
CRLF	End of line marker (carriage return/line feed pair)

All other characters should be included in the message as shown.

6.1.3. Numeric values - NNN

All numeric values (denoted by **NNN** above) are formatted as follows:

- 6.1.3.1. One or more digits (integer part)
- 6.1.3.2. Optional decimal point (if present, shown as ‘.’ Character). Only present if value contains at least one decimal digit
- 6.1.3.3. Zero or more digits (decimal part)
- 6.1.3.4. All values are positive
- 6.1.3.5. Some examples

0
1.234
12.43
125.5
2540

6.1.4. Error detection – CRC

Both commands and responses can include an optional CRC error detection field.

- 6.1.4.1. If included the CRC field will be located between the trailing ‘)’ and ‘>’ characters in the message.
If included, the CRC field will have the following format:
 - 6.1.4.2. Four digit, hexadecimal number, in uppercase.
 - 6.1.4.3. CRC calculated to the CRC-CCITT specification.
 - 6.1.4.4. CRC calculation applied to all characters in message, from starting ‘<’ to trailing ‘)’ character, inclusive.

7. Amendments

7.1. Initial release (01)

7.2. Initial release (02)

Amended after meeting with Steve Tearle/Andy Mitham (2012-07-12)

7.3. Initial release (03)

Amended to include ‘Online data’ command as requested by Phil Bradley

7.4. Initial release (04)

Original text in **Instrument Zero** and **Request Data** paragraph headers is ambiguous. Amended text to remove ambiguity and further clarify required command format (feedback from Andy Mitham).

7.5. Initial release (05)

Added **AUTO** option to **Measurement Range** command (feedback from Andy Mitham).

7.6. Initial release (06)

Added code **0x20** (space character) to the list of permitted characters, for **User Text lines 1 and 2** (feedback from Andy Mitham).

Added reply character (**0x44**) to **Re-initialise** command description.

7.7. Initial release (07)

Document edited to remove legacy references. Instruments are now CEL-712 Microdust Pro and the original Microdust Pro.