SMART INTERFACE

FX

OPERATING INSTRUCTION

Rev. G

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1. INFORMATION

Applicable for FX Software Version: 5.1/6.1

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2. RS232/RS485 INTERFACE

2.1. Protocol

The communication protocol between the system and the FX is based on question/answer. The system sends a command and waits for a response from the FX before to send another command. If the system sends a command before receiving the answer from a previous command, the command will be ignored.

The communication is a RS232/RS485 (depends of your configuration) standard on the J2 connector with the following configuration:

- Baudrate : 115200 bd/s
- Data Bits : 8 bits
- Parity : None
- Stop Bits : 1 bit
- Flow Control : None

To send data to the FX, the RS232/RS485 frame has to match with the following format:

<ST><ST><LEN><DATA><CHKSUMOK><CHKSUM><ET>

- <*ST*> = **0x0F** = **S**tart **T**ransmission → 1 byte
- <*LEN*> = **Len**gth of <*DATA*> (in term of bytes) → 1 byte
- <*DATA*> = **Data** (Command, command response, status, ...) → 1 or more byte
- <*CHKSUMOK*> = If this byte is different from **0x00** then the next byte is the checksum → 1 byte
- <*CHKSUM*> = **Ch**ec**ksum** if <*CHKSUMOK*> is different from **0x00**. **Ch**ec**ksum** is Two's complement of <*DATA*> addition → 1 byte
- <*ET*> = **0xAA** = **E**nd **T**ransmission → One byte

The FX will send the answer to the system with the same frame format.

2.2. FX Command

To communicate with the FX, several commands are available and an overview is shown in the following table:

Command	Value	Description	Explication
RD_F_COUNTER	0x00	Read the number of flash generated	**Part f**
RD_RF_COUNTER	0x01	Read the number of flash requested	**Part f**
INTERNAL_CMD	0x02	Internal command (Do not used)	**-**
GENE_FLASH_TRIG_2	0x03	Generate flash with the trigger 2	**Part c**
GENE_FLASH_TRIG_1	0x04	Generate flash with the trigger 1	**Part c**
WR_ E_LEVEL_TRIG_2	0x05	Change the energy level of the trigger 2 (Old command, should not be used)	**Part a**
WR_E_LEVEL_TRIG_1	0x06	Change the energy level of the trigger 1 (Old command, should not	**Part a**

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		be used)	
SV_ TRIG_SETTINGS	0x07	Save the settings of both triggers	**Part b**
RD_SV_TRIG_SETTINGS	0x08	Read the saved settings of the triggers	**Part b**
GENE_SEQ_TEST	0x09	Generate a flash sequence test	**Part c**
RD_CHARGE_VOLT	0x0A	Read the capacitor charge voltage	**Part f**
RD_TEMP	0x0B	Read the FX temperature	**Part f**
INTERNAL_CMD	0x0C	Internal command (Do not used)	**-**
RD_VERSION	0x0D	Read the software version	**Part f**
DIAGNOSIS	0x0E	Execute a diagnosis sequence	**Part i**
RD_C_VOLT_SETTING	0x0F	Read the capacitor charge voltage setting	**Part f**
C_STANDBY	0x10	Start/Stop a complete standby	**Part g**
P_STANDBY	0x11	Start/Stop a partial standby	**Part g**
RD_FLASH_STATUS	0x12	Read the status of the last flash	**Part c**
RESET_UC_HT	0x13	Reset High Voltage part of the FX	**Part h**
RESET_UC_COM	0x14	Reset Communication part of the FX	**Part h**
RESET_UC_FX	0x15	Reset High Voltage and Communication parts of the FX	**Part h**
RD_EE_HT_FAILED_COUNTER	0x16	Read the number of failed writing operation on the EEPROM memory of the FX	**Part f**
SET_SEQ_FLASH_TRIG_1	0x17	Set the flash sequence of the trigger 1	**Part a**
SET_SEQ_FLASH_TRIG_2	0x18	Set the flash sequence of the trigger 2	**Part a**
SET_OUTPUT_TRIG_MODE	0x19	Set the output trigger mode	**Part e**

In the following parts are described each command with explication. Examples are provided in the next chapter with an overview of command formats and command responses.

a. Flash settings

The FX has two different triggers. Each trigger can generate a sequence of 4 flashes with a different lapse time between and before each flash and with a different energy level.

The *SET_SEQ_FLASH_TRIG_1* and *SET_SEQ_FLASH_TRIG_2* commands set the sequence for each trigger. The command need to be built as following:

<SET_SEQ_FLASH_TRIG_x><NUMBER OF FLASHES><ENERGY LEVEL FLASH 1><ENERGY LEVEL FLASH n+1><TIME BEFORE FLASH 1 MSB><TIME BEFORE FLASH 1 LSB><TIME BETWEEN FLASH n & n+1 MSB><TIME BETWEEN FLASH n & n+1 LSB>

- *<SET_SEQ_FLASH_TRIG_x>* = 0x17/0x18 → 1 byte
- *<NUMBER OF FLASHES>* = Number of flash in the sequence. Between 1 and 4 → 1 byte
- *<ENERGY LEVEL FLASH 1>* = Energy level of the first flash (Refer to the corresponding table) → 1 byte
- *<ENERGY LEVEL FLASH n+1>* = Energy level for the flash 2, 3 and 4 (Refer to the corresponding table). The number of byte depend of the number of flash, if number of flash is set to 1 this byte is omitted, if the number of flash is set to 2 there is only 1 byte, ...
- *<TIME BEFORE FLASH 1 MSB><TIME BEFORE FLASH 1 LSB>* = 2 bytes corresponding to the lapse time before the first flash. This time is in millisecond and can be set between 0 and 65535
- *<TIME BETWEEN FLASH n & n+1 MSB><TIME BETWEEN FLASH n & n+1 LSB>* = Lapse time between flash 1 & 2, between flash 2 & 3, between 3 & 4. The time is on 2 bytes and like the

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energy level, if the number of flash is set to 1 those bytes are omitted, if the number of flash is set to 2 there is only 2 bytes (= 1 lapse time), ... This time is in millisecond and can be set between 1 and 65535

The response from the FX to those commands will be:

<SET_SEQ_FLASH_TRIG_x><CMD_OK = 0x00> if the command is OK

Or

<SET_SEQ_FLASH_TRIG_x><SEQ_ERROR = 0x0C> if the command is not OK. It means the command is not built correctly.

In order to be compatible with previous software version of the FX, the *WR_ E_LEVEL_TRIG_2* and *WR_E_LEVEL_TRIG_1* commands are also available to change the energy level of the first flash of each trigger but should not be used (*SET_SEQ_FLASH_TRIG_1* and *SET_SEQ_FLASH_TRIG_2* commands should be used). The frame format of this command is as following:

<WR_E_LEVEL_TRIG_x><ENERGY LEVEL>

- *<WR_E_LEVEL_TRIG_x>* = 0x05/0x06 → 1 byte
- *<ENERGY LEVEL>* = Energy level of the first flash of the sequence (Refer to the corresponding table) → 1 byte

The response from the FX to those commands will be:

<WR_E_LEVEL_TRIG_x><CMD_OK = 0x00> if the command is OK

Or

<WR_E_LEVEL_TRIG_x><LEVEL_E_NOK = 0x07> if the command is not OK. It means the command is not built correctly.

b. Saving flash settings

In order to save the settings for each trigger in the EEPROM memory of the FX, the *SV_TRIG_SETTINGS* command is available. The command has no parameters so the command format is only built with this byte (0x07).

The response from the FX to this command will be:

<SV_TRIG_SETTINGS><CMD_OK = 0x00> if the command is OK

Or

<SV_TRIG_SETTINGS><EEPROM_ERROR = 0x14> if the command is not OK. It means the command is not built correctly

The saved settings can be read with the *RD_SV_TRIG_SETTINGS* command. This command has to be built as following:

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<RD_SV_TRIG_SETTINGS><TRIGGER NUM>

- *<RD_SV_TRIG_SETTINGS>* = 0x08 → 1 byte
- *<TRIGGER NUM>* = Number of the trigger that we want to read (1 or 2) → 1 byte

The response from the FX to this command will be:

<RD_SV_TRIG_SETTINGS><RD_SV_TRIG_SETTINGS_ERROR = 0x15> if the command is not OK. It means the command is not built correctly

Or

<RD_SV_TRIG_SETTINGS><TRIGGER NUM><NUMBER OF FLASHES><ENERGY LEVEL FLASH 1><ENERGY LEVEL FLASH n+1><TIME BEFORE FLASH 1 MSB><TIME BEFORE FLASH 1 LSB><TIME BETWEEN FLASH n & n+1 MSB><TIME BETWEEN FLASH n & n+1 LSB> if the command is OK (The response is built like the *SET_SEQ_FLASH_TRIG_1* and *SET_SEQ_FLASH_TRIG_2* commands with the addition of the number of the trigger)

c. Generate Flash

To generate a flash through the RS232/RS485 interface the *GENE_FLASH_TRIG_1* and *GENE_FLASH_TRIG_2* commands are available. The command has no parameters so the command format is only built with the byte *GENE_FLASH_TRIG_1* (0x04) for the trigger 1 and *GENE_FLASH_TRIG_2* (0x03) for the trigger 2.

The response from the FX to this command is always:

<GENE_FLASH_TRIG_1><CMD_OK = 0x00>

To know if a flash really happened and if not to know why, the *RD_FLASH_STATUS* command is available. The command has no parameters so the command format is only built with this byte (0x12).

The response from the FX to those commands will be:

<RD_FLASH_STATUS><FLASH_GENERATED = 0x02*><Voltage before Flash MSB><Voltage before Flash LSB><Voltage after Flash MSB><Voltage after Flash LSB><Voltage delta MSB><Voltage delta LSB><Energy>* if the flash really happened (The voltages must be multiply by 0.301 to convert from digit to voltage)

Or

<RD_FLASH_STATUS><FLASH_MISSED = 0x03> if the flash has been missed because the flash tube is weak

Or

<RD_FLASH_STATUS><FLASH_N_READY = 0x04> if the flash has been missed because the charge voltage of the capacitors is too low

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Or

<RD_FLASH_STATUS><FLASH_OVERRUN = 0x12> if the flash has been missed because the FX has generated too many flashes in a short time.

It is possible to generate an unlimited number of flashes without sending trigger with the *GENE_SEQ_TEST* command. To start the generation the command need to be built as following:

<GENE_SEQ_TEST><START SEQ><PERIOD MSB><PERIOD LSB><ENERGY LEVEL>

- *<GENE_SEQ_TEST>* = 0x09 → 1 byte
- *<START SEQ>* = 0x0A → 1 byte
- *<PERIOD MSB><PERIOD LSB>* = 2 bytes corresponding to the lapse time between two flashes. This time is in millisecond and can be set between 1 and 65535
- *<ENERGY LEVEL>* = Energy level of the first flash of the trigger 1

To stop the generation:

<GENE_SEQ_TEST><STOP SEQ>

- *<GENE_SEQ_TEST>* = 0x09 → 1 byte
- *<STOP SEQ>* = 0x0B → 1 byte

The response from the FX to those commands will be:

<GENE_SEQ_TEST><START_SEQ = 0x0A> if the generation has started

Or

<GENE_SEQ_TEST><STOP_SEQ = 0x0B> if the generation has stopped

Or

<GENE_SEQ_TEST><SEQ_ERROR = 0x0C> if the command is not OK. It means the command is not built correctly.

d. Output Trigger

The FX has a ''Dry Contact'' output trigger on the pin 4 of the J2 connector called ''OUTPUT_TRIG''. The following diagram shows the output:

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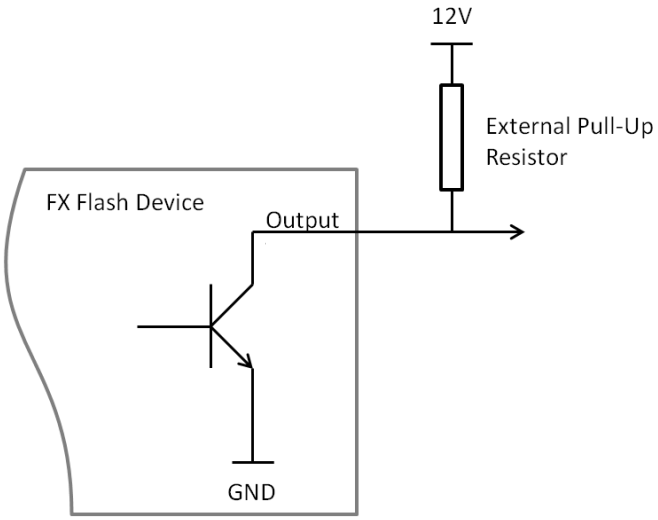
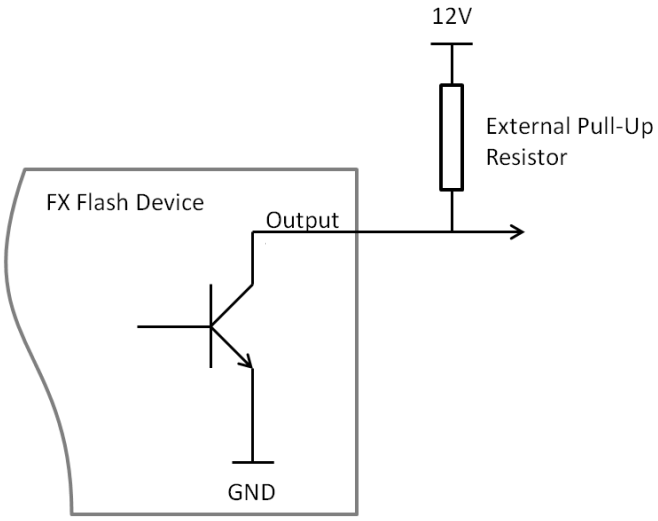


When one of the input triggers (''Dry Contact'' input or ''Trigger 1'' input or ''Trigger 2'' input) is triggered, the output ''OUTPUT_TRIG'' is connected to GND during 100us even if the flash is missed (see also ''Flash Fired flag'').

e. Flash Fired flag

The FX has a ''Dry Contact'' output on the pin 9 of the J1 connector called ''Flash Fired'' which indicate when the FX is flashing. The output is connected to GND during the generation of the flash for all flashes of the trigger sequence or just for the first flash; it depends of the output mode configuration. The following diagram shows the output:



To change the output mode the *SET_OUTPUT_TRIG_MODE* command is available. With this command the mode is automatically saved. The command need to be built as following:

<SET_OUTPUT_TRIG_MODE><OUTPUT TRIGGER MODE>

- *<SET_OUTPUT_TRIG_MODE>* = 0x19 → 1 byte
- *<OUTPUT TRIGGER MODE>* = Output mode. Mode 0 = The output is connected to GND during the generation of the first flash of the trigger sequence. Mode 1 = The output is

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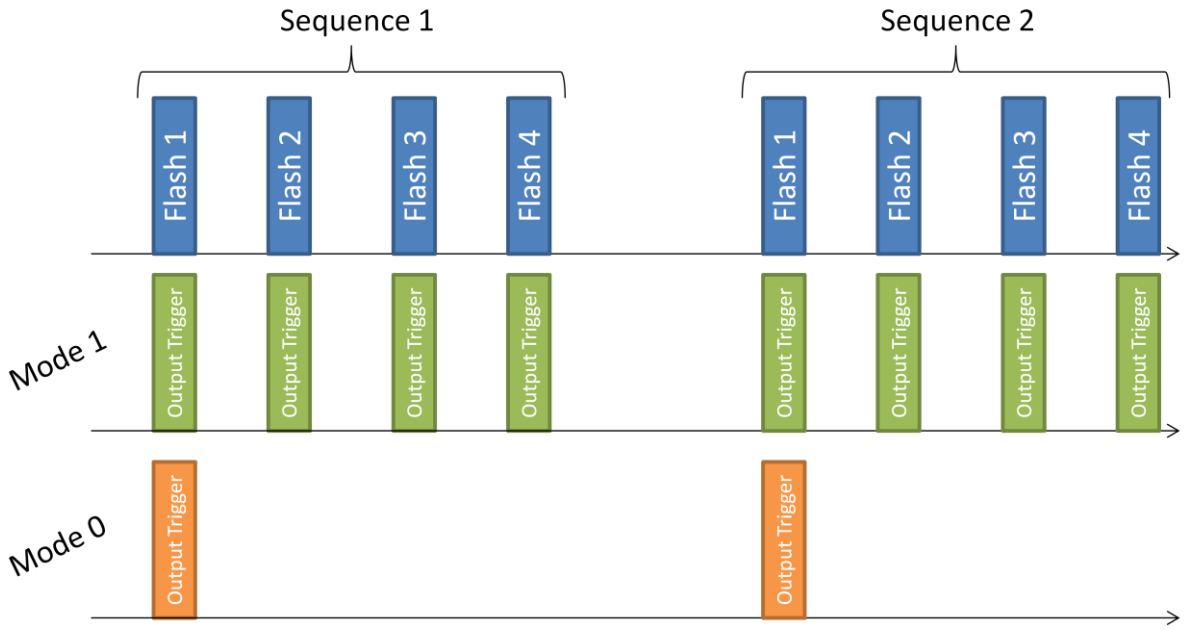
connected to GND during the generation of each flash of the trigger sequence. The following diagram show the two modes:



The response from the FX to this command will be:

<SET_OUTPUT_TRIG_MODE><CMD_OK = 0x00> if the command is OK

Or

<SET_OUTPUT_TRIG_MODE><MODE_ERROR = 0x16> if the command is not OK. It means the command is not built correctly.

f. Monitoring

It is possible to monitor some features in the FX:

- The Generated flash counter (the counter is increased only when a flash trigger sequence is generated successfully):
  - Command format: *<RD_F_COUNTER>*
  - Command response: *<RD_F_COUNTER><COUNTER ON 3 BYTES (MSB first)>*
- The Requested flash counter (the counter is increased when a trigger is trigged)
  - Command format: *<RD_RF_COUNTER>*
  - Command response: *<RD_RF_COUNTER><COUNTER ON 3 BYTES (MSB first)>*
- The charge voltage of the capacitors:
  - Command format: *<RD_CHARGE_VOLT>*
  - Command response: *<RD_CHARGE_VOLT><VOLTAGE ON 2 BYTES (MSB first)>*
- The FX temperature:
  - Command format: *<RD_TEMP>*
  - Command response: *<RD_TEMP><ASCII SYMBOL><TEMPERATURE ON 1 BYTE>*
- The software version of the FX:

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- Command format: *<RD_VERSION>*
- Command response: *<RD_VERSION><VERSION ON 4 BYTES (Version = byte_1.byte_2/byte_3.byte_4)>*

- The charge voltage should be the capacitors:
  - Command format: *<RD_C_VOLT_SETTING>*
  - Command response: *<RD_C_VOLT_SETTING>< VOLTAGE ON 2 BYTES (MSB first)>*
- The number of failed writing operation on the EEPROM memory of the FX:
  - Command format: *<RD_EE_HT_FAILED_COUNTER>*
  - Command response: *<RD_EE_HT_FAILED_COUNTER><COUNTER ON 2 BYTES (MSB first)>*

g. Power reduction

To reduce the power consumption on the FX, it can be put in two modes of standby. In the FX there is two parts: the communication part and the high voltage part. The high voltage part takes care of the loading of the capacitor and it's the part which generates the flash, so this is where we can act to reduce the power consumption. The first standby mode is a complete standby, it means that the high voltage part of the FX is completely switch OFF, the capacitor are not loaded and before to generate a flash the FX needs to be wake up and the capacitor needs to be loaded. The second standby is a partial standby, it means that the high voltage part is switch OFF but every 5 seconds this part is wake up to keep the capacitor voltage to a voltage of 210V in order to be able to generate a flash immediately after a wake up.

The command format for a complete standby and a partial standby takes no parameters and are respectively *<C_STANDBY>* and *<P_STANDBY>.*

The responses to those commands are:

<x_STANDBY><STANDBY ON = 0x10> if the standby has started

Or

<x_STANDBY><STANDBY OFF = 0x11> if the standby has stopped.

/!\ During a standby no command must be sent to the FX except to turn OFF the standby.

h. Software reset

As said in the last part, the FX has two parts: the communication part and the high voltage part. 3 commands are available to reset each part or both:

- Reset high voltage part:
  - Command format: *<RESET_UC_HT>*
  - Command response: No response, wait at least 4 seconds before sending another command
- Reset communication part:

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- Command format: *<RESET_UC_COM>*
- Command response: No response, wait at least 4 seconds before sending another command

- Reset both:
  - Command format: *<RESET_UC_FX>*
  - Command response: No response, wait at least 4 seconds before sending another command

i. Diagnosis

It is possible to run a diagnosis in order to find a problem in the FX. The command format takes no parameter and there is only 1 byte *DIAGNOSIS* (0x0E). Be careful this command will generate some flashes and during the diagnosis no command must be sent to the FX.

The response to this command will be:

<DIAGNOSIS><POWER VOLTAGE><BYTE 1><BYTE 2><BYTE 3><BYTE 4><BYTE 5>

- *<DIAGNOSIS>* = 0x0E → 1 byte
- *<POWER VOLTAGE>* = Power voltage multiplied by 10. The power voltage must be between 9V and 16V → 1 byte
- *<BYTE 1><BYTE 2><BYTE 3><BYTE 4><BYTE 5>* : If the diagnosis is OK all bytes should be at the value 0x0F (DIAGNOSIS_OK), if not (value 0x0E → DIAGNOSIS_KO) refer to the following table to know where come from the problem:

Byte n°1	Byte n°2	Byte n°3	Byte n°4	Byte n°5	Signification[2]
DIAGNOSIS_KO	-[1]	DIAGNOSIS_KO	DIAGNOSIS_KO	DIAGNOSIS_KO	The ''Com Board'' is damaged
-[1]	DIAGNOSIS_KO	-[1]	-[1]	-[1]	The Internal Temperature is too high or too low
DIAGNOSIS_OK	-[1]	DIAGNOSIS_KO	DIAGNOSIS_KO	DIAGNOSIS_KO	The ''Conv Board'' is damaged
DIAGNOSIS_OK	-[1]	DIAGNOSIS_OK	DIAGNOSIS_KO	DIAGNOSIS_KO	The ''Conv Board'' is damaged
DIAGNOSIS_OK	-[1]	DIAGNOSIS_OK	DIAGNOSIS_OK	DIAGNOSIS_KO	If at least one flash is generated then the ''Flash Tube'' is damaged else the ''IGBT Board'' is damaged
DIAGNOSIS_KO	-[1]	DIAGNOSIS_OK	DIAGNOSIS_OK	DIAGNOSIS_OK	Internal communication error during diagnosis

[1]: Don't care

[2]: If any of those situations happen, please retry and/or contact Phoxene Support

2.3. Examples

Overview of command format and command response:

Command	Format	Response	Example
RD_F_COUNTER	*<RD_F_COUNTER>*	*<RD_F_COUNTER><COUNTER ON 3 BYTES (MSB first)>*	**Ex 4**

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RD_RF_COUNTER	*<RD_RF_COUNTER>*	*<RD_RF_COUNTER><COUNTER ON 3 BYTES (MSB first)>*	**Ex 4**
INTERNAL_CMD	-	-	-
GENE_FLASH_TRIG_2	*<GENE_FLASH_TRIG_2>*	*<GENE_FLASH_TRIG_2><CMD_OK>*	**Ex 3**
GENE_FLASH_TRIG_1	*<GENE_FLASH_TRIG_1>*	*<GENE_FLASH_TRIG_1><CMD_OK>*	**Ex 3**
WR_ E_LEVEL_TRIG_2 (Old command)	*<WR_E_LEVEL_TRIG_2><ENERGY LEVEL>*	*<WR_E_LEVEL_TRIG_2><CMD_OK>* OR *<WR_E_LEVEL_TRIG_2><LEVEL_E_NOK>*	-
WR_E_LEVEL_TRIG_1 (Old command)	*<WR_E_LEVEL_TRIG_1><ENERGY LEVEL>*	*<WR_E_LEVEL_TRIG_1><CMD_OK>* OR *<WR_E_LEVEL_TRIG_1><LEVEL_E_NOK>*	-
SV_ TRIG_SETTINGS	*<SV_TRIG_SETTINGS>*	*<SV_TRIG_SETTINGS><CMD_OK>* OR *<SV_TRIG_SETTINGS><EEPROM_ERROR>*	**Ex 2**
RD_SV_TRIG_SETTINGS	*<RD_SV_TRIG_SETTINGS><TRIGGER NUM>*	*<RD_SV_TRIG_SETTINGS><RD_SV_TRIG_SETTINGS_ERROR>* OR *<RD_SV_TRIG_SETTINGS><TRIGGER NUM><NUMBER OF FLASHES><ENERGY LEVEL FLASH 1><ENERGY LEVEL FLASH n+1><TIME BEFORE FLASH 1 MSB><TIME BEFORE FLASH 1 LSB><TIME BETWEEN FLASH n & n+1 MSB><TIME BETWEEN FLASH n & n+1 LSB>*	**Ex 2**
GENE_SEQ_TEST	To Start : *<GENE_SEQ_TEST><START SEQ><PERIOD MSB><PERIOD LSB><ENERGY LEVEL>* To Stop: *<GENE_SEQ_TEST><STOP SEQ>*	*<GENE_SEQ_TEST><START_SEQ>* OR *<GENE_SEQ_TEST><STOP_SEQ>* OR *<GENE_SEQ_TEST><SEQ_ERROR>*	-
RD_CHARGE_VOLT	*<RD_CHARGE_VOLT>*	*<RD_CHARGE_VOLT><VOLTAGE ON 2 BYTES (MSB first)>*	-
RD_TEMP	*<RD_TEMP>*	*<RD_TEMP><ASCII SYMBOL><TEMPERATURE ON 1 BYTE>*	-
INTERNAL_CMD	-	-	-
RD_VERSION	*<RD_VERSION>*	*<RD_VERSION><VERSION ON 4 BYTES (Version = byte_1.byte_2/byte_3.byte_4)>*	-
DIAGNOSIS	*<DIAGNOSIS>*	*<DIAGNOSIS><POWER VOLTAGE><BYTE 1><BYTE 2><BYTE 3><BYTE 4><BYTE 5>*	-
RD_C_VOLT_SETTING	*<RD_C_VOLT_SETTING>*	*<RD_C_VOLT_SETTING><VOLTAGE ON 2 BYTES (MSB first)>*	-
C_STANDBY	*<C_STANDBY>*	*<C_STANDBY><STANDBY_ON>* OR *<C_STANDBY><STANDBY_OFF>*	-
P_STANDBY	*<P_STANDBY>*	*<P_STANDBY><STANDBY_ON>* OR *<P_STANDBY><STANDBY_OFF>*	-
RD_FLASH_STATUS	*<RD_FLASH_STATUS>*	*<RD_FLASH_STATUS><FLASH_GENERATED>><Voltage before Flash MSB><Voltage before Flash LSB><Voltage after Flash MSB><Voltage after Flash LSB><Voltage*	**Ex 3**

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		delta MSB><Voltage delta LSB><Energy> OR *<RD_FLASH_STATUS><FLASH_MISSED>* OR *<RD_FLASH_STATUS><FLASH_N_READY>* OR *<RD_FLASH_STATUS><FLASH OVERRUN>*	
RESET_UC_HT	*<RESET_UC_HT>*	No response, wait at least 4 seconds before sending another command	-
RESET_UC_COM	*<RESET_UC_COM>*	No response, wait at least 4 seconds before sending another command	-
RESET_UC_FX	<RESET_UC_FX>	No response, wait at least 4 seconds before sending another command	-
RD_EE_HT_FAILED_COUNTER	*<RD_EE_HT_FAILED_COUNTER>*	*<RD_EE_HT_FAILED_COUNTER><COUNTER ON 2 BYTES (MSB first)>*	-
SET_SEQ_FLASH_TRIG_1	*<SET_SEQ_FLASH_TRIG_1><NUMBER OF FLASHES><ENERGY LEVEL FLASH 1><ENERGY LEVEL FLASH n+1><TIME BEFORE FLASH 1 MSB><TIME BEFORE FLASH 1 LSB><TIME BETWEEN FLASH n & n+1 MSB><TIME BETWEEN FLASH n & n+1 LSB>*	*<SET_SEQ_FLASH_TRIG_1><CMD_OK>* OR *<SET_SEQ_FLASH_TRIG_1><SEQ_ERROR>*	**Ex 1**
SET_SEQ_FLASH_TRIG_2	*<SET_SEQ_FLASH_TRIG_2><NUMBER OF FLASHES><ENERGY LEVEL FLASH 1><ENERGY LEVEL FLASH n+1><TIME BEFORE FLASH 1 MSB><TIME BEFORE FLASH 1 LSB><TIME BETWEEN FLASH n & n+1 MSB><TIME BETWEEN FLASH n & n+1 LSB>*	*<SET_SEQ_FLASH_TRIG_2><CMD_OK>* OR *<SET_SEQ_FLASH_TRIG_2><SEQ_ERROR>*	**Ex 1**
SET_OUTPUT_TRIG_MODE	*<SET_OUTPUT_TRIG_MODE><OUTPUT TRIGGER MODE>*	*<SET_OUTPUT_TRIG_MODE><MODE_ERROR>*	

Overview of the command response value:

Status	Value	Description
CMD_OK	0x00	Command correctly performed
NO_MATCHING_CMD	0x01	The received command don't match with any known command
FLASH_GENERATED	0x02	Flash generated
FLASH_MISSED	0x03	Flash missed
FLASH_N_READY	0x04	Flash not ready (the charge voltage is too low)
INTERNAL_ERROR	0x05	Internal error
INTERNAL_ERROR	0x06	Internal error
LEVEL_E_NOK	0x07	Can't change the energy level
INTERNAL_ERROR	0x08	Internal error
RD_VERSION_ERROR	0x09	Can't read software version
START_SEQ	0x0A	Flash sequence started
STOP_SEQ	0x0B	Flash sequence stopped
SEQ_ERROR	0x0C	Can't start or stop flash sequence

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INTERNAL_ERROR	0x0D	Internal error
DIAGNOSIS_KO	0x0E	Diagnosis succeed
DIAGNOSIS_OK	0x0F	Diagnosis failed
STANDBY_ON	0x10	Standby (complete or partial) started
STANDBY_OFF	0x11	Standby (complete or partial) stopped
FLASH_OVERRUN	0x12	Flash overrun (too many flash are generated)
FLASH_ERROR	0x13	Flash error
EEPROM_ERROR	0x14	Eeprom error
RD_SV_TRIG_SETTINGS_ERROR	0x15	Can't read saved triggers settings
MODE_ERROR	0x16	Output trigger mode error

Example 1:

Setting 3 flashes for the trigger 1 with 3 different energy levels (level 0, 2 & 5) and 3 different times (before flash 1: 6ms, between flash 1 & 2: 100ms, between flash 2 & 3: 200ms) and 1 flash for the trigger 2 with an energy level of 0 and a time before the flash to 0s.

Command to send for the first trigger:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x0B><0x17><0x03><0x00><0x02><0x05><0x00><0x06><0x00><0x64><0x00><0xC8><NO CKSUM = 0x00><ET = 0xAA>

Receiving response from the FX:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x02><0x17><0x00><NO CKSUM = 0x00><ET = 0xAA>

Meaning of the response: Trigger set correctly

Command to send for the second trigger:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x05><0x18><0x01><0x00><0x00><0x00><NO CKSUM = 0x00><ET = 0xAA>

Receiving response from the FX:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x02><0x18><0x00><NO CKSUM = 0x00><ET = 0xAA>

Meaning of the response: Trigger set correctly

Example 2:

Saving the triggers set in the Example 1 and reading the saved settings of the trigger 2.

Command to send to save the triggers:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x01><0x07><NO CKSUM = 0x00><ET = 0xAA>

Receiving response from the FX:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x02><0x07><0x00><NO CKSUM = 0x00><ET = 0xAA>

Meaning of the response: Triggers settings saved

Command to send to read the saved settings of the trigger 2:

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<ST = 0x0F><ST = 0x0F><LENGTH = 0x02><0x08><0x02><NO CKSUM = 0x00><ET = 0xAA>

Receiving response from the FX:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x06><0x08><0x02><0x01><0x00><0x00><0x00><NO CKSUM = 0x00><ET = 0xAA>

Meaning of the response: Trigger 2; 1 flash; level 0; time before the flash 0ms

Example 3:

Generating a flash sequence with the trigger 1 (same for the trigger 2) and reading the status of the flashes.

Command to send to generate the sequence:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x01><0x04><NO CKSUM = 0x00><ET = 0xAA>

Receiving response from the FX:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x02><0x04><0x00><NO CKSUM = 0x00><ET = 0xAA>

Meaning of the response: Command sent correctly

Command to send to read the status:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x01><0x12><NO CKSUM = 0x00><ET = 0xAA>

Receiving response from the FX:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x09><0x12><0x02><0x03><0x81><0x03><0x60><0x00><0x21><0x14><NO CKSUM = 0x00><ET = 0xAA>

Meaning of the response: Sequence generated with following features:

- Voltage before flash = <0x03><0x81> * 0.301 = 0x381 * 0.301 = 897 * 0.301 = 270V
- Voltage after flash = <0x03><0x60> * 0.301 = 0x360 * 0.301 = 864 * 0.301 = 260V
- Voltage delta of the flash = <0x00><0x21> * 0.301 = 0x21 * 0.301 = 33 * 0.301 = 9.93V
- Energy of the flash = <0x14> = 20J

Example 4:

Reading flash counter (same for the flash request counter).

Command to send to read the counter:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x01><0x00><NO CKSUM = 0x00><ET = 0xAA>

Receiving response from the FX:

<ST = 0x0F><ST = 0x0F><LENGTH = 0x04><0x00><0x00><0x01><0xAE><NO CKSUM = 0x00><ET = 0xAA>

Meaning of the response: Counter = 0x0001AE = 430

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2.4. Error

Sometimes the FX can response to a command with an error due to several things. The frame format for the error is as following:

<*ERROR*><*ERROR_BASE*><*ERROR_NUM*>

- <*ERROR*> = **0x3E** = **Error** byte
- <*ERROR_BASE*> = Where come from the error byte (RS232/RS485, internal, ...)
- <*ERROR_NUM*> = **Error num**ber

Table of *ERROR_BASE*:

ERROR_BASE	Value	Description
RS232/RS485_BASE	0x10	The error is from the RS232/RS485 interface (checksum is always send with this kind of error)
CMD_BASE	0x20	The error is from the command
INTERNAL_BASE	0x30	The error is internal

Table of RS232/RS485 error:

Error num	Value	Description
LENGTH_NOK	0x02	The length of <DATA> is not OK
CHKSUM_ERROR	0x03	The calculated checksum is not the same that the received checksum
RS232/RS485_TIMEOUT	0x04	The frame took too much time to arrived to the FX (the max time between each byte is 1 second)
FRAME_ERROR	0x05	The received frame don't match with the frame format

Table of Command error:

Error num	Value	Description
NO_MATCHING_CMD	0x01	The received command don't match with any known command

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3. ENERGY LEVELS

The following table show the rated energy for each level:

Energy	Level
FX1 = 60J - FX2 = 50J	0
10J	1
15J	2
20J	3
25J	4
30J	5
35J	6
40J	7
45J	8
50J	9
55J	10(A)
60J	11(B)
65J	12(C)
70J	13(D)
75J	14(E)
80J	15(F)

If the system change the level with a value higher than 15 then the level will be 15.

If the FX has the mechanical switch option then the switch will change the first flash of the trigger 1.

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