

LRF SOFTWARE INTERFACE CONTROL DOCUMENT (ICD)

LASER-RANGEFINDER MODULES, KITS, AND COMPONENTS

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VOXTELOPTO

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MULTI-PULSE RANGING

<i>Command</i>	<i>Multi Pulse Extended Range</i>
<i>Description</i>	Requests seven ranging events; it is useful for extending range and increasing range accuracy by binning all echo results to find the largest bin distance value. One echo return is reported; for any return without data, a zero is returned. There are no parameter fields.
<i>Command Syntax</i>	:ER
<i>Command Example</i>	:ER Range request, internal trigger
<i>Response Syntax</i>	~ER [binned range data] OK
<i>Response Values</i>	Range data Units are 0.1 meter
<i>Response Example</i>	~ER 15643 OK Range is 1,564.3 meters, no errors

TIME-OVER-THRESHOLD (TOT) RANGE

<i>Command</i>	<i>Time-over-threshold Range</i>
<i>Description</i>	Triggers a single range event. The rising and falling edge of each return are used to apply a range-walk correction. This is useful for improving range accuracy
<i>Command Syntax</i>	:TR
<i>Command Example</i>	:TR Time-over-threshold range
<i>Response Syntax</i>	~TR 1501, 3502 OK
	The first time-over-threshold range-walk-corrected result is 150.1 m and the second is 350.2 m, no errors

FALSE-ALARM RATE (FAR) CALIBRATION

<i>Command</i>	<i>FAR Calibration</i>
<i>Description</i>	Calibrates the low-threshold voltage (v_{ThLo}) for a FAR at 60 Hz; the low-threshold voltage value is updated, but is not saved to memory
<i>Command Syntax</i>	:CL
<i>Command Example</i>	:CL FAR calibration request
<i>Response Syntax</i>	~CL vThLo NOT set curr: 1200, prev: 1200 OK
	Return shows previous setting and now-current low-threshold-voltage setting.
<i>Response Values</i>	Range data Previous and current low-threshold voltage settings
<i>Response Example</i>	~CL vThLo NOT set Low-threshold voltage in DAC LSBs, no errors curr: 1200, prev: 1200 OK

PULSE DETECTION

<i>Command</i>	<i>Pulse Detection</i>
<i>Description</i>	Displays the frequency of a train of incoming laser pulses
<i>Command Syntax</i>	:PD
<i>Command Example</i>	:PD Pulse detection request
<i>Response Syntax</i>	~PD 1000 [292], 0 [0], 0 [0], 0 [0], 0 [0] OK Frequency is given in Hertz; number of occurrences is given in brackets.
<i>Response Values</i>	Five different sets of pulse detections and counts.
<i>Response Example</i>	~PD 1000 [292], 0 [0], 0 [0], 0 [0], 0 [0] OK A frequency of 1 kHz was detected 292 times, no errors

STANDY MODE

The *Standby Mode* minimizes power draw by powering down the high voltage circuits.

<i>Command</i>	<i>Standby Mode</i>
<i>Description</i>	Enables or disable the high-voltage power to the receiver. By default, the LRF operates in a low-power mode.
<i>Command Syntax</i>	:SM [mode]
<i>Command Parameter Values</i>	command 0 = exit standby, 1 = enter standby
<i>Command Example</i>	:SM 1 Commands the LRF to enter standby mode
<i>Response Syntax</i>	~SM [mode] OK
<i>Response Values</i>	command 0 = exit standby, 1 = enter standby
<i>Response Example</i>	~SM 1 OK LRF is in standby mode, no errors

CONFIGURE LRF

Configures the LRF using the *command parameter values* described below. The command parameter values are used, along with factory-calibrated data, to configure the LRF and achieve application-specific performance.

External Trigger

Enables the external trigger for the *Range Request* command. Upon selection of *External Trigger*, the LRF executes the Range Request command for each trigger received. The external trigger is a TTL-level signal that is active when in a low-voltage state.

Time-Variied Threshold (TVT)

Enables time-variable threshold (TVT). The TVT functionality is achieved through an RC filter circuit in the ROX APD photoreceiver. The time constant is set to 2.6 μ s, unless custom-configured

False-alarm Rate

Applies the optimized bias and threshold settings to achieve the user-defined false-alarm rate.

Mode

Commands configuration of the modes of the photoreceiver. See ROX Photoreceiver datasheet for the description of the available modes.

Comparator Threshold Levels

Commands the values for the high and low threshold voltage levels for the comparator used for pulse detection.

$V_{th\ hi}$: The high threshold voltage level. Threshold value at the beginning of the range operation.

$V_{th\ lo}$: The low threshold voltage level: The low comparator threshold value, $V_{th\ lo}$ is optional; in the absence of a low comparator threshold value, the factory-calibrated value is used.

$V_{th\ ErLo}$: Threshold voltage level used in multi-pulse processing

Set T_0 Signal Input

Commands use of either the internal or external inputs to reset the range counter at the initiation of each range request. When internal T_0 is selected, the LRF module uses optical backscatter from the outgoing transmitter pulse, detected by the APD photoreceiver, to reset the range counter. When external T_0 is selected, the LRF module uses an electrical input to reset the counter. The external T_0 input is TTL-level, active high.

Command	Configure LRF																		
<i>Description</i>	Sets operating conditions of the LRF.																		
<i>Command Syntax</i>	:CF [external trigger] [TVT] [FAR] [Mode], [V _{th hi}], [V _{th lo}], [V _{th ErLo}], [Ext T ₀] <CR>																		
<i>Command Parameter Values</i>	<table border="0"> <tr> <td>External trigger</td> <td>0 = disable 1 = Range Request command</td> </tr> <tr> <td>TVT</td> <td>0 = off, 1 = on</td> </tr> <tr> <td>FAR</td> <td>0 = default</td> </tr> <tr> <td>Command</td> <td>0 = mode 1 1 = mode 2 2 = mode 3 3 = mode 4</td> </tr> <tr> <td>V_{th hi}</td> <td>Voltage threshold high setting Value from 0-4095</td> </tr> <tr> <td>V_{th lo}</td> <td>Voltage threshold low setting Value from 0-4095 ≤ V_{th hi} 0 = value determined by optimum sensitivity</td> </tr> <tr> <td>V_{th ErLo}</td> <td>voltage threshold low setting used in multi-pulse processing Value from 0-4095</td> </tr> <tr> <td>Ext T₀</td> <td>Use a user-supplied external T₀ signal for laser range. 1 = use an external T₀ 0 = use an internal T₀</td> </tr> </table>	External trigger	0 = disable 1 = Range Request command	TVT	0 = off, 1 = on	FAR	0 = default	Command	0 = mode 1 1 = mode 2 2 = mode 3 3 = mode 4	V _{th hi}	Voltage threshold high setting Value from 0-4095	V _{th lo}	Voltage threshold low setting Value from 0-4095 ≤ V _{th hi} 0 = value determined by optimum sensitivity	V _{th ErLo}	voltage threshold low setting used in multi-pulse processing Value from 0-4095	Ext T ₀	Use a user-supplied external T ₀ signal for laser range. 1 = use an external T ₀ 0 = use an internal T ₀		
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<i>Response Syntax</i>	~CF [external trigger] [TVT] [FAR] [RxGain, [V _{th hi}], [V _{th lo}], [V _{th ErLo}], [Ext T ₀] OK																		
<i>Response Example</i>	~CF LRF configured with no errors 0101, 1433, 1082, 1024, 0 OK																		

FIRMWARE VERSION

<i>Command</i>	<i>Version of firmware</i>
<i>Description</i>	Displays the current software version.
<i>Command Syntax</i>	:VE
<i>Command Parameter Values</i>	none
<i>Command Example</i>	:VE Return current software version
<i>Response Syntax</i>	~VE 2.0.16 OK
<i>Response Values</i>	version 0-9.0-9.0-9

FPGA VERSION

<i>Command</i>	<i>Version of FPGA</i>
<i>Description</i>	Displays the current FPGA version.
<i>Command Syntax</i>	:VF
<i>Command Parameter Values</i>	none
<i>Command Example</i>	:VF Return current FPGA version
<i>Response Syntax</i>	~VF 1.0.2 OK
<i>Response Values</i>	version 0-9.0-9.0-9

SAVE USER SETTINGS

<i>Command</i>	<i>Save User</i>
<i>Description</i>	Saves the current configuration setting.
<i>Command Syntax</i>	:SV
<i>Command Parameter Values</i>	none
<i>Command Example</i>	:SV Save user settings
<i>Response Syntax</i>	~SV OK
<i>Response Values</i>	None

RESTORE FACTORY SETTINGS

<i>Command</i>	<i>Restore Factory</i>
<i>Description</i>	Restores the factory configuration setting.
<i>Command Syntax</i>	:RF
<i>Command Parameter Values</i>	none
<i>Command Example</i>	:RF Restores factory settings
<i>Response Syntax</i>	~RF OK
<i>Response Values</i>	None

RANGE CALIBRATION

<i>Command</i>	<i>Range Calibration</i>	
<i>Description</i>	Specifies range calibration offset (decimeters) to be applied to each range return result.	
<i>Command Syntax</i>	:RC	
<i>Command Parameter Values</i>	Offset	Offset in decimeters
<i>Command Example</i>	:RC 2	Add 2 decimeters to each range return result.
<i>Response Syntax</i>	~RC 2 OK	
<i>Response Values</i>	offset	Offset of 2 decimeters.

ERROR CODES

<i>Error code</i>	<i>Description</i>
1000	An :RR range request did not receive a T ₀ pulse.
1001	An :RR range request received a T ₀ pulse, but did not receive any return pulses.
1002	An :RR range request is already in progress.
1100	An :ER multiple pulse range did not receive a T ₀ pulse.
1101	An :ER multiple pulse received a T ₀ pulse, and not any return pulses.
1102	An :ER multiple pulse range is already in progress.
2000	A TDC action is already in progress.
2100	An SPI command was sent to the FPGA, but an ACK was not received. Calibration may be in progress. The FPGA may not be programmed.