

Detailed Register Definitions

The rangefinder can be configured using an I2C machine interface. Settings control the acquisition and processing of ranging data. The I2C interface supports a transfer rate up to 100kb per second. Control Registers are divided between "internal" microprocessor registers and "external" registers residing in the Correlation processor. The internal registers are mapped to register addresses from 0 to 15 hex and external registers from 40 to 68 hex. Internal registers are both read and write, while external registers are read or write only. The most significant bit of the address byte in the I2C address byte triggers the auto incrementing of register address with successive reads or writes within an I2C block transfer.

Control Registers

μP internal Control Registers

Register	Description
control_reg [0x0]	Command Control
control_reg [0x1]	Status - system status.
control_reg [0x2]	Maximum acquisition count
control_reg [0x3]	Correlation record length setting
control_reg [0x4]	Acquisition mode control
control_reg [0x5]	Measured threshold offset during acquisition
control_reg [0x6-7]	Measured delay of reference in correlation record
control_reg [0x8]	Reference correlation measured peak value
control_reg [0x9]	Velocity Measurement Output

control_reg [0xab]	Measured delay of signal return in correlation record
control_reg [0xc]	Signal correlation measured peak value
control_reg [0xd]	Correlation record noise floor * 1.25 (for setting valid signal threshold)
control_reg [0xe]	Received signal strength (typical range 10 min - 128 maximum)
control_reg [0xf-10]	Calculated distance in cm (difference between signal and reference delay)
control_reg [0x11]	DC threshold command value
control_reg [0x12]	Added delay to reduce signal acquisition burst frequency
control_reg [0x13]	Distance calibration. Signed 8 bit value adds or subtracts from distance
control_reg [0x14-15]	Previous measured distance

Correlation Core External Control Registers

Register	Description
control_reg [0x40]	Command register
control_reg [0x41]	Hardware Version
control_reg [0x42]	Preamp DC control
control_reg [0x43]	Transmit power control
control_reg [0x44]	Processing range gate (low byte)
control_reg [0x45]	Processing range gate (high byte)
control_reg	

[0x46]	Range Measurement PWM output pin bit[0] used
control_reg [0x47]	Acquisition status
control_reg [0x49]	Measured preamp DC offset
control_reg [0x4a]	Output port
control_reg [0x4b]	Range Processing Criteria for two echoes. Max signal, Max/Min Range.
control_reg [0x4c]	2nd largest detected peak in signal correlation record.
control_reg [0x4f]	Software Version.
control_reg [0x51]	Correlation record size select - (reference and signal return)
control_reg [0x52]	Correlation Data access port (low byte)
control_reg [0x53]	Acquisition Settings - selects ext. memory access, signal record select
control_reg [0x57-8]	Measured delay of reference or signal in correlation window
control_reg [0x59]	Correlation peak value of reference or signal
control_reg [0x5a]	Correlation record noise floor * 1.25 (for setting valid signal threshold)
control_reg [0x5b]	Received signal strength (typical range 10 minimum to 255 maximum)
control_reg [0x5c]	Reset correlator / increment transmit signal pattern
control_reg [0x5d]	Correlation Data access port (sign bit)
control_reg [0x5e]	Clock synchronizer control
control_reg	Measured transmit power - Supports Laser safety monitoring

[0x5f]	
control_reg [0x60]	Measured fine delay (used as part of measured delay calculation)
control_reg [0x61-62]	Coarse delay (used as part of measured delay calculation)
control_reg [0x63]	Positive correlation sample before zero crossing (correlation pulse falling edge)
control_reg [0x64]	Negative correlation sample after zero crossing (correlation pulse falling edge)
control_reg [0x65]	Power control settings
control_reg [0x68]	Velocity measurement window setting register

Internal Register Descriptions

Unless otherwise noted, all registers contain one byte and are read and write.

0x00 (control_reg[0]:)

Notes

- Command Register
- Write 0x00 to Register 0x00: Reset FPGA. Re-loads FPGA from internal Flash memory: all registers return to default values
- Write 0x03 to Register 0x00: Take acquisition & correlation processing without DC correction
- Write 0x04 to Register 0x00: Take acquisition & correlation processing with DC correction

0x01 - Mode/Status (control_reg[1]:)

Bit	Function	Notes
Bit 7	Eye Safe	This bit will go high if eye-safety protection has been activated
Bit 6	Error Detection	Process error detected / measurement invalid
Bit 5	Health	"1" if good, "0" if bad
Bit 4	Secondary return	Secondary return detected above correlation noise floor threshold
Bit 3	Signal not valid	Indicates that the signal correlation peak is equal to or below correlation record noise threshold
Bit 2	Sig overflow flag	Overflow detected in correlation process associated with a signal acquisition
Bit 1	Ref overflow flag	Overflow detected in correlation process associated with a reference acquisition
Bit 0	Ready Status	"0" is ready for new command, "1" is busy with acquisition

Health status indicates that the preamp is operating properly, transmit power is active and a reference pulse has been processed and has been stored.

0x02 (control_reg[2]:)

Notes

- Controls Maximum Acquisition Count
- Default Value: 0x80
- Range: 0x00-0xFF (0-255).
- Controls the FPGA maximum signal integration time.
- Stronger signal results in reduced acquisition count to prevent internal register overflow.
- Signal overflow flag and Reference overflow flag in Control Register [1] are set when automatic limiting occurs.

0x03 (control_reg [3]:)

Bit	Function
Bits 7-4	Stop address (default 5 corresponding to 512)
Bits 3-0	Start address (default 1 corresponding to 64)

Notes

- control_reg[0x51]: Correlation start and stop locations used for signal acquisition (write only)
- Start address: Value in the range from 0x00-0x0f – starting point in correlation record (record broken into 64 element segments 1024 total)
- Stop address: Value in the range from 0x00-0x0f – stopping point in correlation record
- With longer correlation records, burst pulse period is roughly proportional to the length of the correlation record. Unnecessarily long record length increases the probability of false detections.

0x04 – Mode Control (control_reg[4]:)

Bit	Function
Bit 7	Velocity
Bit 6	Inhibit Reference
Bit 5	Velocity Scale factor (also used to set delay between measurements in burst/continuous measurement mode)
Bit 4	Disable reference filter
Bit 3	Disable short signal acquisition (runs to the correlation limit of 250)
Bit 2	Disable short reference (allows reference maximum count from reference acquisition count register rather than default value of 0x05)

Bit 1	CLK SHUT
Bit 0	Preamp Off

Notes

- Mode Pin Settings:
 - "0" is normal mode pin triggering with free-running PWM.
 - "1" is status output (busy active high)
 - "2" is Fixed frequency PWM out
 - "3" is 32kHz oscillator output for oscillator frequency calibration
 - Default Value: 0x00
 - Velocity Scale factor: "1" sets the velocity measurement separation to a frequency set by measurement rate register resulting in a velocity calibration in meters/sec. A "0" value results in a measurement separation of 100msec.
 - Inhibit Reference : "1" inhibits the acquisition of reference pulses reducing measurement times and reducing measurement variations at the expense of decreasing accuracy over time. "0" allows normal operation
 - Velocity: Enable velocity measurement
 - Reference Filter averages 8 reference measurements for reduced measurement variability [increased measurement consistency?]
-

0x05 (control_reg[5]:)

Notes

- Nominal 128
 - Measured DC value out of correlation sampler input. Value based on the ratio of 1's and 0's (read only) preamp
 - Parameter used as part of health flag criteria
-

0x06 (control_reg [6]:)

Notes

- [Read Only]: High byte of calculated delay of reference- calculated after correlation record processing
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0x07 (control_reg [7]:)

Notes

- [Read Only]: Low byte of calculated delay of reference- calculated after correlation record processing
-

0x08 (control_reg [8]:)

Notes

- Correlation Peak value reference [Read Only]: (scaled to 0 - 0xff max peak value) - Parameter used as part of health flag criteria
-

0x09 (control_reg [9]:)

Notes

- Velocity [Read Only]: in .1 meters/sec (8 bit signed value) See Mode Control, Register 0x04 for information on changing the scale factor to 1m/sec
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0x0a (control_reg [10]:)

Notes

- High byte of calculated delay of signal correlation [Read Only]: calculated after correlation record processing
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0x0b (control_reg [11]:)

Notes

- Low byte of calculated delay of signal correlation [Read Only]: calculated after correlation record processing
-

0x0c (control_reg [12]:)

Notes

- Correlation Peak value of signal correlation [Read Only]: (scaled to 0 – 0xff max peak value)
-

0x0d (control_reg [13]:)

Notes

- Maximum noise within correlation record [Read Only]: scaled by 1.25 (typically between 0x10–0x30)
-

0x0e (control_reg [14]:)

Notes

- Calculated signal strength [Read Only]: Calculation based on the number of averaged samples and correlation peak value
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0x0f (control_reg [15]:)

Notes

- High byte of calculated delay of signal [Read Only]: reference – calculated after correlation record processing
 - If the MSB is 1 then the reading is not considered valid.
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0x10 (control_reg [16]:)

Notes

- Low byte of calculated delay of signal [Read Only]: reference – calculated after correlation record processing
-

0x11 (control_reg [17]:)

Notes

- Outer Loop Count: Allows multiple measurements with a single measurement command. If set to - 'Off', continuous measurement will be performed. A value of less than 0xff will

terminate continuous measurement after that amount of measurements (ex. 0xfe will take 254 measurements and stop).

0x12 (control_reg [18]:)

Notes

- Reference Acquisition Count: Normal setting is 0x05 to force multiple reference acquisitions before updating the reference delay used in the calculation of distance.
 - Note: Short Reference Distance Flag [2] in Register 4 must be set to enable operation of a reference count other than the default value.
-

0x13 (control_reg [19]:)

Notes

- Distance Calibration value: The value is added to measured distance. 8bit signed value allows increasing or decreasing the measured value.
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0x14 (control_reg [20]:)

Notes

- Previous high byte of calculated delay of signal [Read Only]: reference
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0x15 (control_reg [21]:)

Notes

- Previous low byte of calculated delay of signal [Read Only]: reference
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0x16 (control_reg [22]:)

Notes

- Upper byte of unit serial #
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0x17 (control_reg [23]:)

Notes

- Lower byte of unit serial #
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0x18 (control_reg [24]:)

Notes

- Load upper register serial # (reg [22]) into register [24] to allow changing I2C address
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0x19 (control_reg [25]:)

Notes

- Load lower register serial # (reg [23] into register [25] to allow I2C register loading

0x1a (control_reg [26]:)

Notes

- I2C address of desired new I2C address
-

0x1c (control_reg [28]:)

Notes

- Threshold by-pass. Overrides the automatic setting of the detection threshold. If value \neq 0, can base threshold on measured noise and the peak signal value to decrease false alarms or to improve sensitivity.
-

0x1d (control_reg [29]:)

Notes

- I2C address read off the bus (last access)
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0x1e (control_reg [30]:)

Notes

- I2C configuration bits. Writing register initiates change in I2C address if Register 0x16 is set to the value in Register 0x18 AND Register 0x17 is set to the value in Register 0x19. [3]
 - Keeps primary address open after programming secondary address. Other bits

presently not used.

External Register Descriptions

Unless otherwise noted, all registers contain one byte and are read and write.

0x40 - Command Control (control_reg[64]:)

Bit	Description
Bit 7	Peak Processing Flag
Bit 6	Perform Correlation Process Flag
Bit 5	Signal Acquisition Flag
Bit 4	Clear Correlation Memory Flag
Bit 3	Store Template Pattern Enable Flag
Bit 0 ... Bit 2	Starting action address

Bits 0 through 2 Definitions

Value	Description
000	No Operation
001	Start processes at template store
010	Clear Correlation Record
011	Signal Acquisition
100	Start processes at Perform Correlation process
101	Start processes at Delay calculation Processing

110	NOP
111	Perform only correlation record filtering - Test Mode Enable

Notes

- Command control register: Writing to this register through the I2C interface immediately initiates a command operation. Thus it is important to initiate this command only at the completion of defining other registers.
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0x41 (control_reg[65]:)

Notes

- Hardware Version: revisions begin with 0x01
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0x42 (control_reg[66]:)

Notes

- Preamp DC control: Range 0-255
 - Used in DC compensation servo loop
-

0x43 (control_reg[67]:)

Bit	Description
Bits 4-7	Reference Power Control (0x0 to 0xf)
Bits 0-3	Signal Power Control (0x0 to 0xf)

Notes

- Transmit power control: Laser drive control bits (7 through 4) ref, bits (3 through 0) signal.
 - Maximum value set at factory 3amps. The maximum output power of the optical source is set through a factory selected resistor which limits available current to the transmit source.
 - When using laser devices, which have a much higher operating current, do not increase the reference control level beyond the factory settings.
 - Increasing the reference control level may cause premature failure of the internal reference diode.
-

0x45 (control_reg[69]:)

Notes

- Measurement Delay - Sets the time between measurements. 0xc8 corresponds to 10Hz while 0x13 corresponds to 100Hz. Minimum value is 0x02 for proper operation.
 - The velocity scale factor flag in Register 0x04 must be set to operate at the non-default value. The measurement time will ultimately limit the maximum achievable rate in burst or continuous operation.
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0x48 (control_reg [72]:)

Notes

- Health Status Flags:
 - [0] Health Flag
 - [1] Reference is working
 - [2] Transmit power is good
 - [3] DC is good (pre-amp status)

0x49 (control_reg [73]:)

Notes

- Measured DC value out of correlation sampler input [Read Only]: Value based on the ratio of 1's and 0's
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0x4b (control_reg [75]:)

Bit	Function	Notes
Bit 7	Disable DC Correction	Skips DC stabilization. Used to increase repetition rate
Bit 6	NOT USED	
Bit 5	NOT USED	
Bit 4	Select Reference/Signal	Selects Reference or Signal Records when operating from control register 0x40
Bit 3	NOT USED	
Bit 2	Select Max Range	"1" selects the longer distance; "0" selects the shorter distance
Bit 1	Select Range Criteria	"1" selects return data based on distance; "0" selects strongest return, regardless of distance
Bit 0	Select Second Return	Controls echo processing selection : "1" switches to alternative return; "0" Selects data associated with detection criteria

Notes

- Mode Configuration Register
 - Range Processing Criteria for two echoes: Max signal, Max/Min Range.
-

0x4c (control_reg [76]:)

Notes

- Peak Value of 2nd largest pulse in the signal correlation record [Read Only]
-

0x4d (control_reg [77]:)

Notes

- Inner loop count (working)
-

0x4f (control_reg[79]:)

Notes

- Software Version: Revisions begin with 0x01
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0x51 (control_reg [81]:)

Bit	Function	Notes
Bits 4-7	Stop Address	Value in the range from 0x00-0x0f – stopping point in correlation record
Bits 0-3	Start Address	Value in the range from 0x00-0x0f – starting point in correlation record (record broken into 64 element segments 1024 total

Notes

- Correlation start and stop locations [Write Only]
 - Not used in general use (working register)
-

0x52 (control_reg [82]:)

Notes

- Data from memory records [Read Only]: Template memory, Signal memory or Correlation memory (low byte of 9 bit value)
-

0x53 (control_reg [83]:)

Notes

- Correlation Data Sign [0]
 - Acquisition and control settings [Write Only]
-

0x5a (control_reg [90]:)

Notes

- Maximum noise within correlation record [Read Only]: Scaled by 1.25 (typically between 0x10 – 0x30)
-

0x5c (control_reg [92]:)

Notes

- Reset Control Register (working register)

0x5d (control_reg [93]:)

Acquisition Settings

Bit	Notes
Bits 7-6	[1]: Access template memory, [2]: Access signal memory, [3]: Access correlation memory
Bits 5-0	NOT USED

0x5f (control_reg [95]:)

Notes

- Measured transmit power [Read Only]: Using internal power monitor

0x60 (control_reg [96]:)

Notes

- Fine delay [Read Only]: Interpolated fine delay (0-29)

0x61 (control_reg [97]:)

Notes

- Peak Index high byte [Read Only]: Coarse crossing point in the correlation record prior to zero crossing
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0x62 (control_reg [98]:)

Notes

- Peak Index low byte [Read Only]: Coarse crossing point in the correlation record prior to zero crossing
-

0x63 (control_reg [99]:)

Notes

- Positive Crossing - Upper correlation pulse data value prior to zero crossing
- Used to interpolate fine delay

0x64 (control_reg [100]:)

Notes

- Negative Crossing: Lower correlation pulse data value after zero crossing
 - Used to interpolate fine delay
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0x65 (control_reg [101]:)

Bit	Function
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Bit 7	NOT USED
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Bit 6	NOT USED
Bit 5	NOT USED
Bit 4	NOT USED
Bit 3	Det Bias Disable
Bit 2	SLEEP - Initiates partial FPGA shutdown
Bit 1	RCVR PWR Disable. OSC disable if "1"
Bit 0	Analog enable - turns off preamp if "1"

Notes:

- Power control [Write Only]
- Default Value: 0x00
- OSC Disable: Disables oscillator reference – Not used in Lidar-Lite SPC
- RCVR PWR Disable: Turns on receiver regulator – decreases power consumption by 30mA when inhibited
- SLEEP: Processor sleep – Reduces power to 20mA with other hardware disabled (wakes on I2C transaction) Send dummy prior to any command or register access operation.
- Det Bias Disable: Turns off detector bias charge pump