ELECTRO-OPTIC DEVICES, INC.

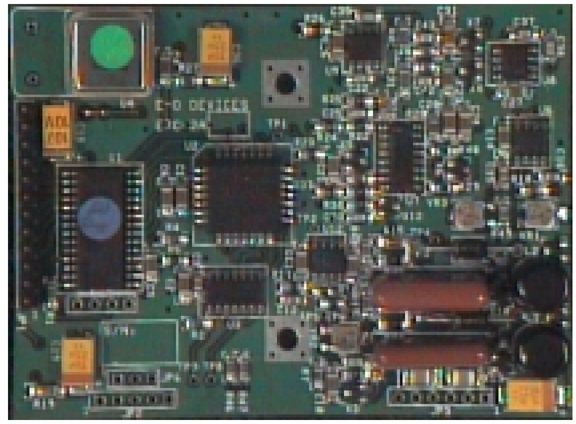
ERC-2A

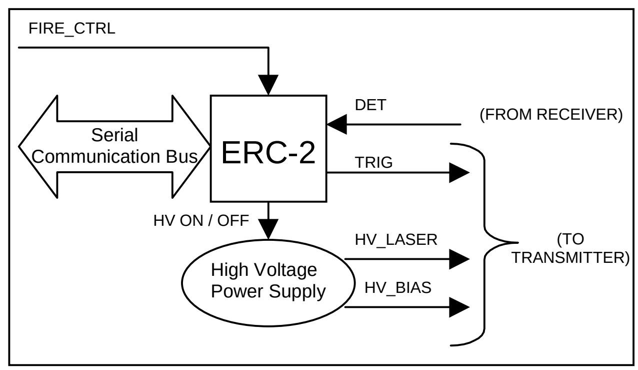
Single Board Ranging Controller

Firmware version 1.08a

FEATURES:

- Single sample range accuracy of +/- 1 foot, better on strong targets.
- On-board power supplies for ETX-series pulsed laser diode drivers.
- Directly interfaces to ERX-5X receiver and ETX-4X laser diode driver.
- PRF to 125 Hz with on-board laser power, nearly 1 kHz with external power supply.
- Maximum range gate of 20.4 µs (appx. 10,000 feet) – extendible to 65 µs.
- Programmable range blanking from 0 to 5 µs (~2,500 ft.) in 20 ns (10 ft) steps.
- Communicates with host via synchronous 3- or 4-wire serial interface.
- Simple command set allowing software or hardware initiated events.
- Three byte time interval result in nanoseconds (16 bits whole/8 bits fractional).
- Requires +12Vdc and +5 Vdc power supplies.
- Compact circuit board just 3.25 x 2.40 inches, weight < 1.5 ounces.





DESCRIPTION:

The ERC-2A is a single board ranging controller. It has a single sample range accuracy of +/- 1 foot, which is improved on strong targets. Its maximum range gate is 20.4µs (appx. 10,000 feet) and is extendible to 65µs. The ERC-2A has a PRF of 125 Hz with on-board laser power and is capable of nearly 1 kHz with external power supply. The ERC-2A has programmable range blanking from 0 to 5 µs (~2,500 ft.) in 20ns (10 ft) steps.

The ERC-2A requires +12Vdc and +5Vdc external power supplies. It has an on-board power supplies to supply power to an ETX-series pulsed laser diode drivers. Therefore, it can directly interfaces to ERX-5X receiver and ETX-4X laser diode driver (See ERC-2KIT).

Communication with host is accomplished via synchronous host selectable 3- or 4-wire serial interface. Using a simple command set, the ERC-2A can be configured for software or hardware initiated events. After measurement of range is completed, a three-byte time interval result in nanoseconds (16 bits whole/8 bits fractional) is returned to the host. Optionally, the ERC-2A can also be configured to return a pulse width value of the return signal back with the measurement results. This is helpful for predicting signal strength error.

The ERC-2A is a compact design with circuit board dimensions of just 3.25 x 2.40 inches and weighs less than 1.5 ounces.

Interface Connections:

Connector JP1 (host interface connector)

Pin	Signal	Description
1	VEO	12Vdc for HV power supplies
2	$\overline{\text{MR}}$	Master Reset (low-active)
3	reserved	
4	SDAO	Serial Data Bus Output
5	SCLK	Serial Data Clock
6	SDAI/SDAT	Serial Data Bus Input/Output
7	$\overline{\text{CS}}$	Controller Select (low-active)
8	FIRE_CTRL	Fire Control Input
9	VCC	5Vdc power supply
10	VCC	5Vdc power supply
11	GROUND	
12	GROUND	

Connector JP2 (ERX-5X pulse receiver interface)

Pin	Signal	Description
1	12Vdc	Receiver power supply
2	GROUND	
3	reserved	
4	DETECT	Receiver TTL detection signal
5	GROUND	

Connector JP3 (ETX-4X pulse transmitter interface)

Pin	Signal	Description
1	CM	Current monitor signal
2	GROUND	
3	HV LASER	HV laser supply (variable)
4	HV BIAS	HV bias supply (fixed)
5	GROUND	
6	TRIGGER	TTL trigger signal to fire laser

Signal Description:
(I=input, O=output, I/O=bidirectional)

$\overline{\text{CS}}$ (I) - Controller select handshake signal used during transfer of commands and data between the controller module and the host microprocessor. **$\overline{\text{CS}}$** must be low during communications. Timing details may be found in the section on **communication**.

SDAO (O) - Serial data output between controller and host for synchronous data/command transfer. When using a 4-wire interface, this data line also provides a "data ready" function. After a trigger command is given, this output goes high to indicate conversion is complete and data is available. Timing details may be found in the section on **communication**.

SDAI (I/O) - Serial data input (4-Wire) for synchronous communication between controller and host for data/command transfer.

SDAT (I/O) - Serial data input/output (3-Wire) for both transmit and receive functions to synchronously communicate between controller and host for data/command transfer. When using the 3-wire interface, **SDAT** also provides a "data ready" function. After a trigger command is given, this line becomes a normally high output that goes low to indicate conversion is complete and data is available. Timing details may be found in the section on **communication**.

SCLK (I) - Serial clock input from the host for synchronous data/command transfer. Timing details may be found in the section on **communication**.

FIRE_CTRL (I) - This input initiates a firing event on its rising-edge. To implement hardware firing control, the CONFIG 0 command must be set accordingly.

$\overline{\text{MR}}$ (I) **-** Master reset input. A logic LOW applied to this input performs a hardware reset of the ERC-2.

Operational Adjustments:

The ERC-2A is a single board ranging module containing all control, range timing, time zero detection and laser power supplies necessary for a laser rangefinder. Only two external components are required: Transmitter and Receiver. The ETX-4X laser diode driver is designed for compatibility with the ERC-2 to assume the function of transmitter. The ERX-5X Optical receiver is also compatible for medium sensitivity applications which can benefit from a Si-PIN photodiode.

There are two adjustments on the ERC-2. They are VR1 and VR2 (see illustration on page 2). VR1 sets the laser discharge voltage in the transmitter. The range of adjustment is 50Vdc – 320Vdc. This voltage level should be adjusted for proper performance and eye-safety compliance by experienced personnel. VR2 sets the start clock threshold level for determining when light leaves the laser diode (time "0"). This may require adjustment if the laser discharge voltage is set very low or very high. VR2 should be set while the host system is issuing a ranging command with the ZERO switch activated. Adjust VR2 while monitoring the time zero information returned from the ranging command. A repeatable and stable value is desirable.

Command and Data Formats:

ID = 0, CONFIG 0

b7	b6	b5	b4	b3	b2	b1	b0
0	0	0	COMM	FIRE	DELY	COMP	HVEN

where:

- COMM = COMMUNICATIONS INTERFACE
  - 0 = 3-wire (default)
  - 1 = 4-wire
- FIRE = FIRE CONTROL MODE
  - 0 = software (default)
  - 1 = hardware
- DELY = DELAYED FIRE, HV INH. ON/OFF
  - 0 = off (default)
  - 1 = on
- COMP = RANGE COMPENSATION ON/OFF
  - 0 = off (default)
  - 1 = on
- HVEN = HIGH VOLTAGE ON/OFF
  - 0 = off (default)
  - 1 = on

ID = 1, CONFIG 1

b7	b6	b5	b4	b3	b2	b1	b0
0	0	1	PWEN	rsrv	rsrv	rsrv	rsrv

where:

- PWEN = PULSE WIDTH ENABLE
  - 0 = disable
  - 1 = enable
- rsrv = reserved

ID = 2, RANGE BLANKING CONTROL

b7	b6	b5	b4	b3	b2	b1	b0
0	1	0	BL4	BL3	BL2	BL1	BL0

where:

BL4 - BL0 = range blanking value as follows: (Default = 0)

- 0..1E = 5 bit blanking interval (single byte command).
- 1F = 8 bit blanking interval in second byte. Second byte blanking value must follow this command.

notes:

Blanking interval is set in 20 nanosecond increments.

ID = 3, RANGE (SINGLE-SHOT)

b7	b6	b5	b4	b3	b2	b1	b0
0	1	1	DIST	INTB	CAL	ZERO	rsrv

where:

- DIST = DISTANCE MODE
  - 0 = distance
  - 1 = delta distance ***future version***
- INTB = INTERVAL BYTES
  - 0 = one byte
  - 1 = two bytes ***future version***
- CAL = CALIBRATION ENABLE
  - 0 = disable
  - 1 = enable
- ZERO = RANGE ZERO ENABLE
  - 0 = disable
  - 1 = enable
- rsrv = reserved

result:

Standard three byte result for distance or delta distance

notes:

CAL enabled will calibrate internal range verniers during measure. The new calibration is used in subsequent range determination. ZERO enabled will update and return range zero time (t0). Target time is not returned. The new zero time is used in subsequent range determination. ZERO enabled fires four shots for an average.

ID = 4, RANGE (AVERAGE) - * *future version*

b7	b6	b5	b4	b3	b2	b1	b0
1	0	0	rsrv	rsrv	rsrv	rsrv	rsrv

where:

rsrv = reserved

ID = 5, RANGE (CONTINUOUS) - * *future version*

b7	b6	b5	b4	b3	b2	b1	b0
1	0	1	rsrv	rsrv	rsrv	rsrv	rsrv

where:

rsrv = reserved

ID = 6, RESERVED

ID = 7, DIAGNOSTICS

b7	b6	b5	b4	b3	b2	b1	b0
1	1	1	SCD	ALGN	rsrv	rsrv	rsrv

where:

- SCD = START CLOCK DISABLE
  - 0 = enable
  - 1 = disable
- ALGN = OPTICAL ALIGNMENT MODE
  - 0 = off
  - 1 = on
- rsrv = reserved

Command Details:

<u>CONFIG 0 (ID = 0)</u>

COMM: COMMUNICATIONS INTERFACE
(0 = 3-wire interface(*default)*, 1 = 4-wire interface)

This switch selects the form of hardwired interface for communication between the ERC-2 and the host system. There are a total of four communication signal lines on the ERC-2. They are:

- $\overline{\textbf{CS}}$ - Controller Select
- **SCLK** - Serial CLocK to clock data in and out
- **SDAO**, Serial DAta Output to transmit (not used in 3-Wire interface)
- **SDAI** - Serial DAta Input to receive

- or -

- **SDAT** - Serial DATa for both input/output data transfers.

If the user selects a four wire interface (COMM = 1), Commands are shifted from the host to the ERC-2 on the SDAI line. The SDAO is used to read data from the ERC-2 to the host.

If the user selects a three wire interface (COMM=0), Commands and data are shifted on the SDAT line only. To implement this form of communication, the host must be capable of reversing the communication port direction to support a bidirectional interface.

For more information on communication procedure, see the section on COMMUNICATION.

FIRE: FIRE CONTROL MODE
(0 = software (*default*), 1 = hardware)

This switch selects whether a firing event is initiated via hardware or software. If the user selects software initiated firing (FIRE = 0), the laser diode is fired upon receiving a ranging command. If the users selects hardware initiated firing (FIRE = 1), the laser diode is fired on the rising edge of the FIRE_CTRL input. Please note that the ERC-2 will fire immediately when issued a ranging command even if FIRE = 1, however, subsequent firing events would then require the rising edge of FIRE_CTRL. The three byte result must always be read from the ERC-2 before another firing event can occur regardless of the status of the FIRE switch.

DELY: DELAYED FIRE, HV INH. ON/OFF
(0 = off (*default*), 1 = on)

This switch activates the HV switching power supply inhibit feature. When activated, a firing event does not occur immediately upon receiving the hardware or software firing signal. Instead, the on-board HV power supply is shut-down and allowed 10 µs to quiet before the laser firing event begins. In some applications this is necessary to avoid false alarms (false range measurements) due to switching supply transients.

COMP: RANGE COMPENSATION ON/OFF
(0 = off (*default*), 1 = on)

This switch activates the range compensation feature of the ERC-2. When activated, the range information read from the ERC-2 will be compensated for range error due to laser signal strength variability. This allows the ERC-2 to provide range results accurate to +/- 1 foot for a wide range of target reflectivities. For high accuracy measurements in controlled environments or known targets, this feature may be disabled and compensated via an external algorithm.

HVEN: HIGH VOLTAGE ON/OFF
(0 = off (*default*), 1 = on)

This switch activates the ERC-2 dual output high voltage power supply. The power supply should be activated at least 100 ms before ranging to provide adequate settling time.

<u>CONFIG 1 (ID = 1)</u>

PWEN: PULSE WIDTH ENABLE
(0 = disable (*default*), 1 = enable)

This switch enables a fourth byte in the range result information. The fourth byte is proportional to the pulse width of the return signal. This information may be used by the host system to predict signal strength error, which is a function of signal amplitude, receiver bandwidth and target echo shape/structure.

<u>RANGE BLANKING (ID = 2)</u>

BL0..BL4: BLANKING TIME INTERVAL
(default = 0, none)

The blanking time interval can be used to force the ERC-2 to ignore targets (both real and false alarms) from zero to 5.1 µs (approximately 2500 ft) in increments of 20 ns (~10 ft.). This feature is useful if a near range partial obstruction prevents a laser rangefinder from acquiring an intended target more than 10 feet beyond the obstruction. Obstructions can take the form of solid objects and gaseous or dust clouds. Common examples are tree limbs, tall grass, fog, smoke, snow, rain and dust trails left by vehicles.

Please note that a blanking value of 1 (20 ns or 10 ft.) will NOT blank ranges of 10 ft. or less since a range offset of 60 ns (typ.) is an inherent property of the ERC-2 due to propagational delays. Generally, blanking values must be at least 3 or higher before blanking effects take place. If no blanking is desired, the default value of zero should be used.

BL0 .. BL4 represents a 5-bit blanking interval in increments of 20 nanoseconds (~10 ft) up to hexadecimal $1E (or 600 ns). For longer durations, a full 8-bit blanking interval may be supplies as an operand byte to the blanking command. To do this, the host issues the range blanking command with value $1F followed by an 8-bit blanking interval byte. In this way a blanking interval up to $FF or 5.1µs may be achieved.

<u>RANGE (SINGLE SHOT) (ID = 3)</u>

DIST: DISTANCE MODE
(0 = distance, 1 = delta distance)
(available in future firmware version)

INTB: INTERVAL BYTES
(0 = one byte, 1 = two bytes)
(available in future firmware version)

CAL: CALIBRATION ENABLE
(0 = disable (*default*), 1 = enable)

This switch activates the internal calibration function of the ERC-2. When activated, the ERC-2 will internally calibrate itself prior to ranging. Subsequent ranging without the CAL switch activated will use the last set of calibration data. The CAL switch must be set on the first ranging instruction sent to the ERC-2 by the host. This switch can remain set for all ranging commands, however, this will slow the maximum ranging rate of the ERC-2. Generally, one ranging command with CAL = 1 every few minutes will suffice. This removes range variation due to changes in ambient and internal temperature.

ZERO: RANGE ZERO ENABLE
(0 = disable (*default*), 1 = enable)

This switch activates internal range zeroing. When ZERO = 1, the ERC-2 will measure the system propagational delay from the time the fire signal is generated to the time light is emitted from the laser. Subsequent ranging commands should have this switch disabled. The ERC-2 will internally subtract the range information acquired while ZERO = 1 from subsequent ranging with ZERO = 0. The internal zero value is initialized at 0. If this switch is never activated, range zeroing has no effect. This switch should be activated periodically to remove range offsets due to temperature. This is often done in conjunction with CAL = 1. See also DIAGNOSTICS command switch SCD and the section on RANGING EXAMPLES.

<u>DIAGNOSTICS (ID =7)</u>

SCD: START CLOCK DISABLE
(0 = enable (normal) (*default*), 1 = disable)

This switch disables the internal start clock system. The start clock is derived from the firing and output of optical energy from the laser. The start clock is time zero. If this signal is deactivated the information read back from the ERC-2 will not be corrected for offset. This is useful for diagnostic purposes.

ALGN: OPTICAL ALIGNMENT MODE
(0 = disable (*default*), 1 = enable)

This switch activates the alignment mode of the ERC-2. When activated, the ERC-2 will continuously fire the laser diode at 100 Hz. This is useful for optical alignment and laser power measurements. Ranging functions are disabled during alignment mode and no data is read from the ERC-2.

Result Data Format:

Following a ranging event, a three byte result <u>must</u> be read from the ranging controller. If the ranging was successful (target found), the following three bytes contain a valid time interval measurement result, otherwise the three bytes will contain the value $FF, $00, $FF.

A successful result contains the following data format:

MSB LSB . FRB in units of nanoseconds

The first byte read is the Most Significant Byte (MSB) in whole number nanoseconds. The second byte contains the Least Significant Byte (LSB) in whole number nanoseconds. The third byte contains the FRactional Byte (FRB) in fractional nanoseconds. In binary format, the three byte result takes the form:

2^{15} **………** 2^{2} 2^{1} 2^{0} **.** 2^{-1} 2^{-2} 2^{-3} 2^{-4} 2^{-5} 2^{-6} 2^{-7} 2^{-8}

Ranging Examples:

Basic

A basic laser ranging application will require at least three commands to be issued by the host system.

First, the CONFIG 0 command will establish the operating functions of the ERC-2. For a ranging system communicating with the host via a 4-wire interface, using software-initiated firing, using internal range compensation with no blanking necessary and well shielded from HV power supply transients:

CONFIG 0: **00010011**

After waiting at least 100 ms for the HV power supplies to stabilize, the second command will calibrate and zero the ERC-2:

RANGE (SINGLE SHOT): **01100110**

Subsequently, the zero range information must be read from the ERC-2 (three bytes).

Finally, the third command acquires the range to target using the range command without calibration or zeroing enabled:

RANGE (SINGLE SHOT): **01100000**

Again, the three byte range information is read from the ERC-2 this time as calibrated, zeroed and signal strength compensated range to the target in nanoseconds.

Near Range Obstruction

In this example, a laser rangefinder must acquire a target known to be over 100 feet away during moderately heavy rain. By using the basic ranging procedure above, no range blanking is implemented and ranging attempts yield results of 85 – 95 nanoseconds (approximately 45 feet). These erroneous readings are due to minute laser backscatter from the rain droplets. This is only a problem at close ranges since the amount of backscatter is small.

To overcome this difficulty, we use the blanking feature of the ERC-2. Since the target is further than 100 feet, we should not expect a valid range inside of approximately 2 x 100 = 200 ns. This implies a blanking interval of 10 (10 x 20ns = 200ns). Since the ERC-2 has an internal offset of roughly 60 ns, we add 3 blanking interval units for a total of 13. The new ranging sequence is similar to the basic example above with the addition of the blanking command:

CONFIG 0: **00010011** Configure the ERC-2

RANGE(SS): **01100110** Calibrate and zero

< read three byte offset data>

BLANKING: **01001101** Blanking set for 260ns.

RANGE(SS): **01100000** Acquire target range.

<read three byte range data>

Ranging with maximum sensitivity

For applications requiring an optical receiver's threshold sensitivity to be set at a high false alarm rate, the on-board high voltage switching power supply may cause false alarms, which will impede proper target acquisition. The receiver and laser driver should be fully shielded and properly grounded with either a single point ground or heavy solid ground plane in applications requiring extra receiver sensitivity. Good ground layout planning is paramount.

To eliminate effects of the ERC-2 switching supplies, the DELY switch should be set in the CONFIG 0 command. The basic ranging example now takes on the following form:

CONFIG 0: **00010111** Configure with DELY=1

RANGE(SS): **01100110** Calibrate and zero

< read three byte offset data>

RANGE(SS): **01100000** Acquire target range.

<ranging is delayed by 10 microseconds while the switching supply is shutoff>

<ranging takes place>

<read three byte range data>

Depending upon the laser discharge voltage level, enabling DELY may limit the maximum ranging rate of the ERC-2.

Communication:

General

The ERC-2 has provisions for 3- or 4-wire interface, TTL level, synchronous serial communication. The first command issued to the ERC-2 by the host system should be CONFIG 0 containing the interface selection switch (COMM).

Once the interface method is established, the ERC-2 will then respond to the ranging command with data output on either the **SDAO** (4-wire interface) or SDAT (3-wire interface) signal line. If possible, the 4-wire interface should be chosen to avoid potential communication collisions on **SDAT**.

Four wire interface

Communication implemented with the four-wire interface option is straightforward. Four signals are used to accomplish information transfer: $\overline{\mathbf{CS}}$, **SCLK**, **SDAI**, and **SDAO**.

To write a command to the ERC-2, the host first brings $\overline{\mathbf{CS}}$ low. This instructs the ERC-2 to receive a command from the host. The host then shifts out 8 bits, MSB first, on the SDAI input of the ERC-2. The host must generate the shift clock (**SCLK**) using the rising-edge to cause the controller to sample each data bit. At the end of each byte, the $\overline{\mathbf{CS}}$ input must be returned to logic high.

Information can be read from the ERC-2 only after a range command (or signal on FIRE_CTRL) is issued. For a 4-wire interface, the ERC-2 will indicate that data is available when the **SDAO** output goes logic high.

To read a data byte from the ERC-2, the host first brings $\overline{\mathbf{CS}}$ low. This informs the ERC-2 that the host is ready to receive information and the first data bit (MSB first) is placed on **SDAO**. The host reads the bit by generating a rising **SCLK** signal. A falling-edge signal on **SCLK** then shifts out the next bit. This is repeated for all eight bits then the $\overline{\mathbf{CS}}$ input is returned to logic high. This procedure is repeated for all three data result bytes.

Three wire interface

Communication implemented with the three-wire interface option requires reversal of the **SDAT** signal to provide bi-directional communication. Three signals are used to accomplish information transfer: $\overline{\mathbf{CS}}$, **SCLK**, and **SDAT**.

To write a command to the ERC-2, the host first brings $\overline{\mathbf{CS}}$ low. This instructs the ERC-2 to receive a command from the host. The host then shifts out 8 bits, MSB first, on the **SDAT** input of the ERC-2. The host must generate the shift clock (**SCLK**) using the rising-edge to cause the controller to sample each data bit. At the end of each byte, the $\overline{\mathbf{CS}}$ input must be returned to logic high.

Immediately after issuing a range command, the **SDAT** signal must be reversed such that it is now a data input at the host and an output at the ERC-2. The signal has an internal pull-up resistor such that the signal will remain logic HI until data is available from the ERC-2 at which time it becomes logic low.

When the host sees that data is available from the ERC-2, the information is shifted out on the **SDAT** signal, which is now an output from the ERC-2. It will remain an output until all three bytes of the result have been read.

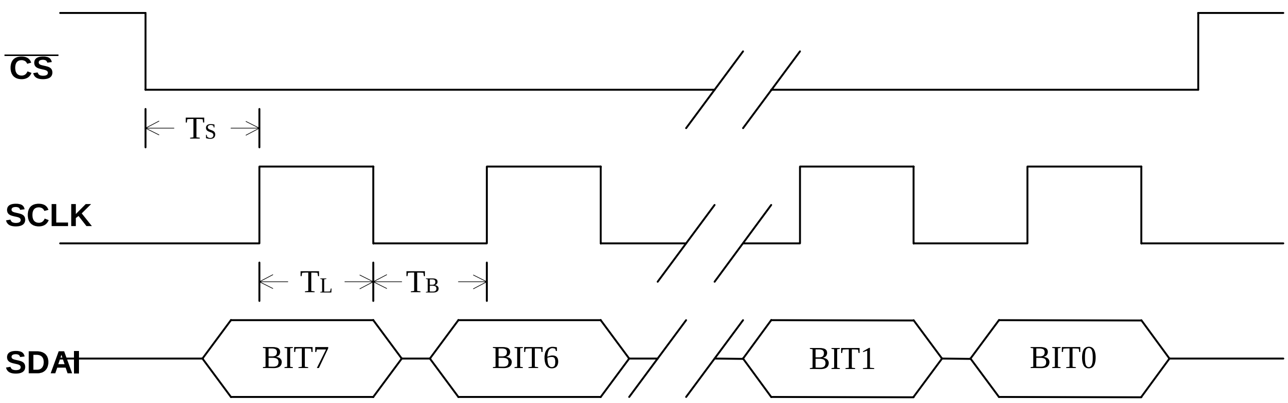
To read a data byte from the ERC-2, the host first brings $\overline{\mathbf{CS}}$ low. This informs the ERC-2 that the host is ready to receive information and the first data bit (MSB first) is placed on **SDAT**. The host reads the bit by generating a rising **SCLK** signal. A falling-edge signal on **SCLK** then shifts out the next bit. This is repeated for all eight bits and then the $\overline{\mathbf{CS}}$ input is returned to logic high. This procedure is repeated for all three data result bytes.

Functional Test Setup:

A functional test of the ERC-2 can be performed by looping back the TRIGGER output on JP3 to the DETECT input on JP2. Be very careful not to accidentally connect to the high voltage pins of JP3. To avoid this possibility, the HVEN switch of CONFIG 0 should be turned OFF (disable the HV supplies). This loop back configuration yields data results of 65 – 75 nanoseconds (typically). A digital delay generator can be inserted into the loop to provide precision tests of the ranging functions of ERC-2. Care should be taken to properly terminate coaxial connections to avoid reflection errors.

A result read back as $FF, $00, $FF implies no range was read. This will occur if the feedback loop is open or no connections are made at JP2 or JP3.

ERC-2 4-Wire Synchronous Receive Time Diagram



Note: Most significant bit received first. **SCLK** should be low before $\overline{\textbf{CS}}$ is brought low.

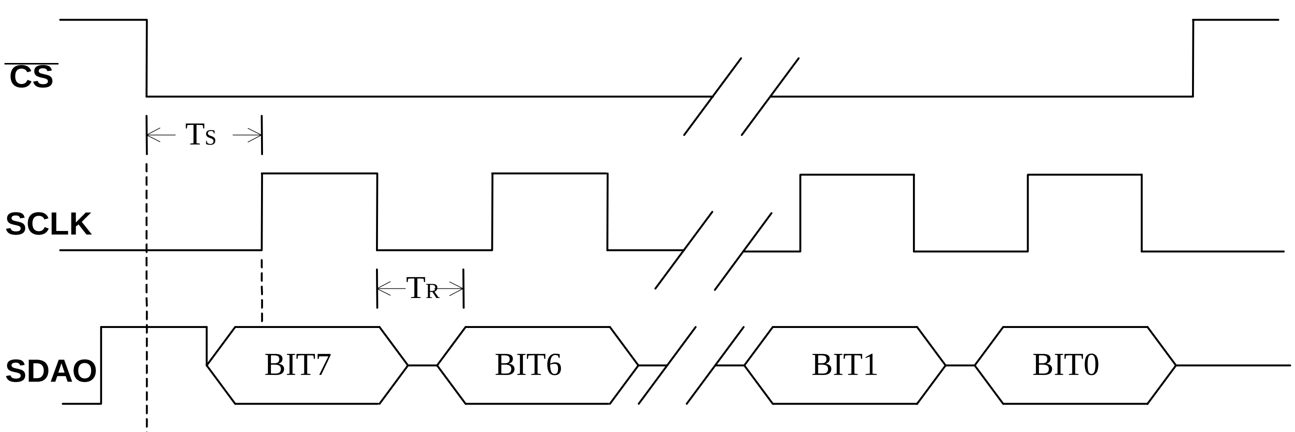
T_S – Setup Time – Minimum time $\overline{\textbf{CS}}$ needs to be low before sending data to the ERC-2 is 2µs.

T_L – Latch Time – Minimum time data should be available after **SCLK** rising edge is 640ns.

T_B – Bit Time – Minimum time before controller is capable of receiving another bit after bit has been latched is 800ns.

*Communicating with an **SCLK** of no more than 500KHz with a 50% duty cycle should be used to assure proper communication.

ERC-2 4-Wire Synchronous Transmit Time Diagram

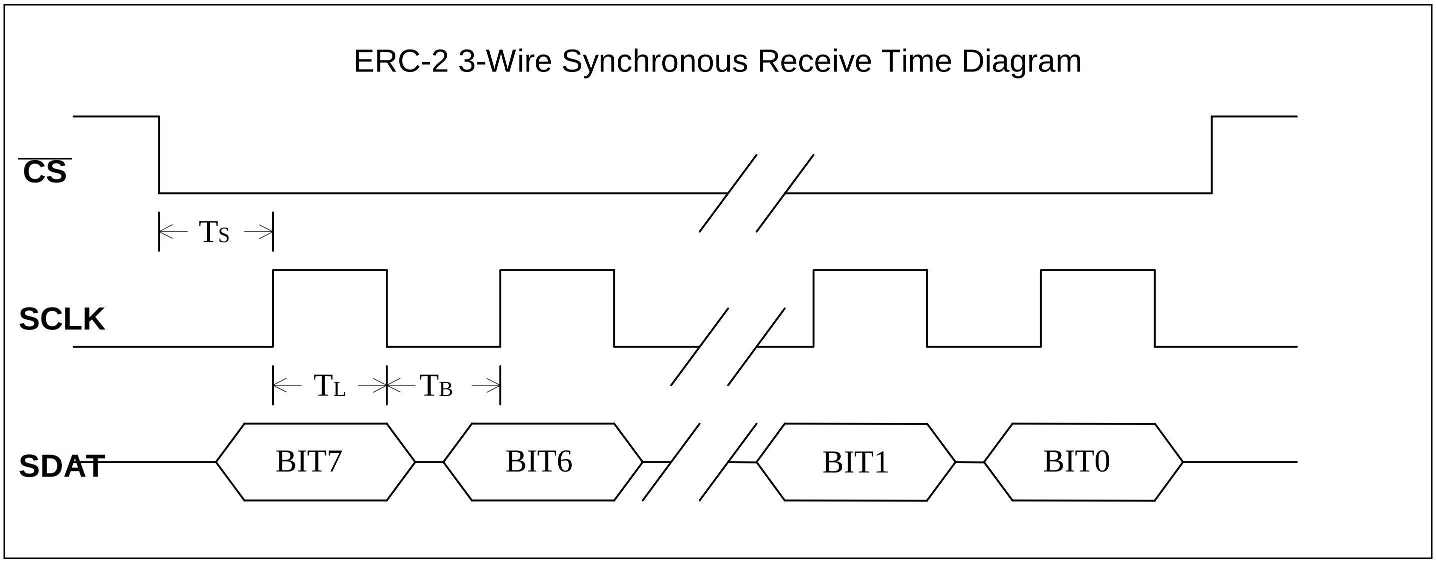


Note: Most significant bit transmitted first. **SCLK** should be low before $\overline{\textbf{CS}}$ is brought low.

T_S – Setup Time – Minimum time $\overline{\textbf{CS}}$ needs to be low before receiving data from ERC-2 is 1.6µs.

T_{TR} – Transition Time – Time from falling edge of **SCLK** before next bit is available is 800ns.

*Communicating with an **SCLK** of no more than 500KHz with a 50% duty cycle should be used to assure proper communication.



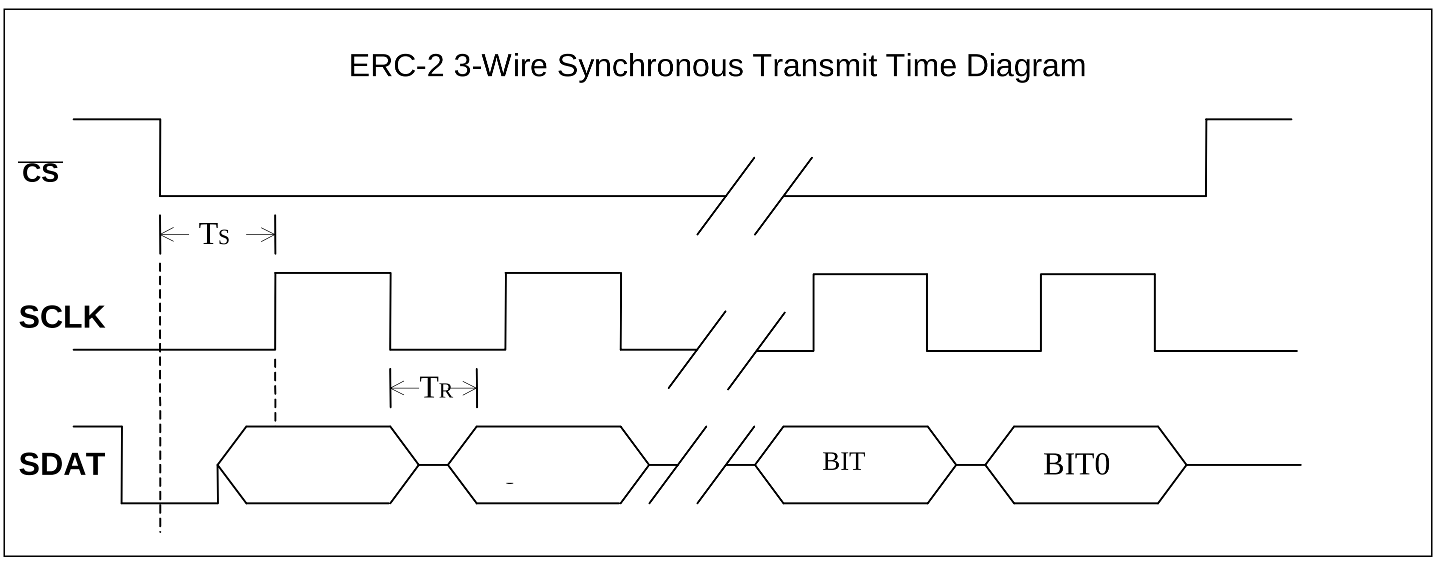
Note: Most significant bit received first. **SCLK** should be low before **$\overline{\text{CS}}$** is brought low.

T_S – Setup Time – Minimum time **$\overline{\text{CS}}$** needs to be low before sending data to the ERC-2 is 2µs.

T_L – Latch Time – Minimum time data should be available after **SCLK** rising edge is 640ns.

T_B – Bit Time – Minimum time before controller is capable of receiving another bit after bit has been latched is 800ns.

*Communicating with an **SCLK** of no more than 500KHz with a 50% duty cycle should be used to assure proper communication.



Note: Most significant bit transmitted first. **SCLK** should be low before **$\overline{\text{CS}}$** is brought low.

T_S – Setup Time – Minimum time **$\overline{\text{CS}}$** needs to be low before receiving data from ERC-2 is 1.6µs.

T_{TR} – Transition Time – Time from falling edge of **SCLK** before next bit is available is 800ns.

*Communicating with an **SCLK** of no more than 500KHz with a 50% duty cycle should be used to assure proper communication.

OPERATING SPECIFICATIONS:

PARAMETER	MIN.	TYP.	MAX.	UNIT
Supply Voltage, Vcc[1]	4.85	5.0	5.15	Vdc
Supply Voltage, Veo[2]	11.0	12.0	13.0	Vdc
Supply Current, Vcc		210		mA
Supply Current, Veo[3]	20	80		mA
$t_{interval}$(IN), time interval range of measurement[4]	0		20.4	µs
$t_{resolution}$(IN), resolution of time interval measurement		20		ps
$t_{accuracy}$(IN), accuracy of time base		0.0025		%
t_{error}, single shot error of measurement (internal correction)[5]		+/- 1		ft
t_{error}, single shot error of measurement (external correction)[6]		+/- 0.25		ft
t_{jitter}, jitter of time interval measurement		100		ps **(RMS)**
t_{pw}(OUT), trigger output pulse width		80		ns
$t_{response}$, response time to data available after triggering		1		ms
$t_{blanking}$, blanking time range	0		5.1	µs

NOTES:
1. The external 5V supply must be regulated and filtered to 5V +/- 0.15V
2. Power supply for optical receiver and HV laser power supplies.
3. Dependent upon laser firing rate and optical receiver current requirements.
4. After correcting for offset (propagational delays). For longer intervals, call technical support.
5. Diffuse target, 10% - 90% lambertian reflectance at 905nm + timebase error.
6. Constant diffuse target or externally corrected data (via correction algorithm).