



SYNRAD Technical Bulletin

020

Technical Issue: Change to Serial Communications (REMOTE RS-232)
Protocol in UC-2000 Firmware Version Release v2.4 and
Upgrade Path for UC-2000 Controller's Running v2.1.

Date: 16 November 2010

Models Affected: UC-2000 Universal Laser Controllers Running Firmware
Version 2.4.

Description:

Firmware version 2.4 introduces a change to the UC-2000 Controller's REMOTE (RS-232) serial communications protocol. This new RS-232 transmission protocol includes a checksum byte to provide a more robust communication link between the UC-2000 Controller and the host PC or PLC by better handling any errors introduced by the transmission line.

By default, all UC-2000 Controllers running firmware version 2.4 will operate using the new checksum protocol to receive REMOTE (RS-232) commands from the host. No other configuration is required **except to implement the new command string structure** as described on the SYNRAD web site at www.synrad.com/ucsc and in the *Using Remote Checksum Commands* section later in this document.

If you plan to operate a UC-2000 Controller running v2.4 firmware using the previous non-checksum single-byte command protocol, you must disable the checksum protocol as described below:

This document contains three sections. The first section, *Procedure To Disable Checksum Communications Protocol*, contains information for those customers with UC-2000 Controllers running firmware version 2.4 who wish to operate using the original non-checksum protocol. The next section, *Using Remote Checksum Commands*, describes the new remote checksum commands and how to implement them. The third section, *Upgrading Your Existing UC-2000 Controller*, contains information about upgrading your existing UC-2000 Controller to use the new RS-232 checksum protocol.

Procedure To Disable Checksum Communications Protocol

Follow these steps to disable the new checksum transmission protocol when operating a UC-2000 Controller running firmware version 2.4:

- 1 To enter Setup mode when power is first applied, press and hold the *Enter* pushbutton while the firmware screen is displayed. At any other time, enter Setup mode by pressing the *Enter* and *Select* buttons simultaneously. After a few seconds the first setup screen appears with the top line, "**FREQUENCY: xxKHZ**", flashing.
- 2 Press the *Select* pushbutton until "**CHECKSUM (ON)**" is flashing.



- 3 Press the *Enter* pushbutton once to disable the checksum protocol. The display will show “**CHECKSUM**”, without the “(ON)”, to indicate the checksum protocol is disabled.

Note: The checksum mode (On or Off) is immediately saved to memory.

- 4 Press Select until “**SAVE AND EXIT**” flashes and then push *Enter* to exit Setup mode. On exit, the UC-2000 Controller beeps twice to indicate that all current operating parameters were successfully saved to non-volatile memory.

As a reminder, factory default settings for UC-2000 Controller running firmware v2.4 are listed below:

Parameter	Default Setting
Frequency	5 kHz
Gate	Pull Up
Maximum PWM Duty Cycle	95%
Lase on Power-Up	N (No)
Checksum	ON

Using Remote Checksum Commands

This section describes how to setup a UC-2000 Controller to operate under REMOTE (RS-232) control in a new checksum mode of operation. This new RS-232 transmission protocol provides a more robust communication link between the UC-2000 Controller and the host PC or PLC by better handling any errors produced in the transmission line. If you are unfamiliar with UC-2000 REMOTE operation and REMOTE command sets, refer to the *UC-2000 Universal Laser Controller Operator’s Manual* for details.

Except for the REMOTE PWM (or SET) Percentage command, all other checksum command sets consist of three bytes: a start transmission byte, a command byte, and a checksum byte.

The REMOTE PWM (or SET) Percentage command consists of four bytes: a start transmission byte, a command byte, a data byte and a checksum byte.

The REMOTE Status Request command is unchanged and consists of a single hexadecimal byte, 7Eh. The Status Request command does not require a start transmission byte or checksum byte and can be sent anytime except between the start transmission byte and the checksum byte of any valid remote command.

Note: All REMOTE commands sent to the Controller from a host computer or PLC are immediately saved to non-volatile memory.



REMOTE Command Sets, Checksum Format

The Command/Response format for sending checksum command sets, except the PWM (or SET) Percentage command, is as follows:

Command Sequence	Response
STX<Command><Checksum>	AAh ACK
	3Fh NAK*

Where:

STX = 5Bh. This character signals the start of transmission when checksum mode is enabled.

<Command> = any valid REMOTE command with the exception of the Set PWM Command, 7Fh.

<Checksum> = a checksum byte created by performing a One's compliment (inverting the bits) of the command byte.

Notes: STX, ACK, and NAK byte values in this protocol are not the standard ASCII character values. *The NAK response is only sent when CHECKSUM mode is enabled (ON).

Example: Send the following REMOTE Lase command to set laser enabled: **5Bh 75h 8Ah**

Upon completion of a valid status or command request, the UC-2000 Controller returns a single byte, AAh, as an acknowledgment of success. A NAK response (3Fh) is sent if no valid command or checksum value is received within 1 second of the STX byte or if the checksum value is incorrect.

REMOTE PWM (or Set) Percentage Command, Checksum Format

The Command/Response format for sending checksum PWM (or Closed Loop SET) percentage commands is as follows:

Set PWM Command Sequence	Response
STX<Command><Data Byte><Checksum>	AAh ACK
	3Fh NAK*

Where:

STX = 5Bh. This character signals the start of transmission when checksum mode is enabled.

<Command> = 7Fh; the command byte for setting the PWM or Closed Loop SET percentage.

<Data Byte> = a valid PWM value as described below in the "REMOTE PWM (or SET) percentage command" section.



<Checksum> = a checksum byte created by adding without carry the Command byte and Data Byte, then performing a One's compliment (inverting the bits) of the sum.

Notes: STX, ACK, and NAK byte values in this protocol are not the standard ASCII character values. *The NAK response is only sent when CHECKSUM mode is enabled (ON).

Example: Send a REMOTE PWM (or SET) percentage command of 63.0%: **5Bh 7Fh 7Eh 02h**

Upon completion of a valid status or command request, the UC-2000 Controller returns a single byte, AAh, as an acknowledgment of success. A NAK response (3Fh) is sent if no valid command, data, or checksum value is received within 1 second of the STX byte or if the checksum value is incorrect.

REMOTE Status Request Command, Checksum Format

The Response format to a Status Request command is as follows:

Status Command	Response
7Eh ACK<	Status Byte1><Status Byte2><PWM Byte><Power Byte><Checksum>

Where:

ACK = AAh

<Status Byte1> = Status Byte1 as described below in the "REMOTE Status Request command" section.

<Status Byte2> = Status Byte2 as described below in the "REMOTE Status Request command" section.

<PWM Byte> = PWM byte as described below in the "REMOTE Status Request command" section.

<Power Byte> = Power byte as described below in the "REMOTE Status Request command" section.

<Checksum> = a checksum byte created by adding without carry Status Byte1, Status Byte2, PWM Byte, and Power Byte, then performing a One's compliment (inverting the bits) of the sum.



Valid REMOTE checksum commands

UC-2000 REMOTE checksum command sets include:

- Mode commands
- Lase commands
- Setup commands
- PWM (or closed loop SET) Percentage command
- Status Request command

REMOTE Mode commands

Function	Command	Response
Set MANUAL mode	STX70h<Checksum>	AAh (ACK) or 3Fh (NAK)
Set ANC mode	STX71h<Checksum>	AAh (ACK) or 3Fh (NAK)
Set ANV mode	STX72h<Checksum>	AAh (ACK) or 3Fh (NAK)
Set MAN. CLOSED mode	STX73h<Checksum>	AAh (ACK) or 3Fh (NAK)
Set ANV CLOSED mode	STX74h<Checksum>	AAh (ACK) or 3Fh (NAK)

REMOTE Lase commands

Function	Command	Response
Set laser enabled	STX75h<Checksum>	AAh (ACK) or 3Fh (NAK)
Set laser standby	STX76h<Checksum>	AAh (ACK) or 3Fh (NAK)



REMOTE Setup commands

Function	Command	Response
Set PWM freq = 5K	STX 77h <Checksum>	AAh (ACK) or 3Fh (NAK)
Set PWM freq = 10K	STX 78h <Checksum>	AAh (ACK) or 3Fh (NAK)
Set PWM freq = 20K	STX 79h <Checksum>	AAh (ACK) or 3Fh (NAK)
Set Gate pull up	STX 7Ah <Checksum>	AAh (ACK) or 3Fh (NAK)
Set Gate pull down	STX 7Bh <Checksum>	AAh (ACK) or 3Fh (NAK)
Set max PWM = 95%	STX 7Ch <Checksum>	AAh (ACK) or 3Fh (NAK)
Set max PWM = 99%	STX 7Dh <Checksum>	AAh (ACK) or 3Fh (NAK)
Enable lase on power-up	STX 30h <Checksum>	AAh (ACK) or 3Fh (NAK)
Disable lase on power-up	STX 31h <Checksum>	AAh (ACK) or 3Fh (NAK)

REMOTE PWM (or SET) percentage command

Function	Command	Response
Set PWM (or SET) Percentage	STX 7Fh <Data Byte><Checksum>	AAh (ACK) or 3Fh (NAK)

Set PWM (or Closed Loop SET) percentage in minimum 0.5% steps, by sending two hexadecimal bytes: a PWM command byte (7Fh) and a data byte. To send a PWM or SET percentage command to the UC-2000 Controller, first multiply the desired PWM percentage by two, and then convert the result to hexadecimal. For example, to command a 70% PWM percentage, multiply 70×2 . Convert the result (140) to hexadecimal format and then send this Data Byte result (8Ch), and a checksum byte, after sending the 7Fh Command byte.



REMOTE Status Request command

Function	Command	Response
Get Status	7Eh	AAh<Status Byte1><Status Byte2><PWM Byte><Power Byte><Checksum>

Read Status Byte1 as follows:

- Bits 0-2** Current operating mode (Bit 0 = LSB; Bit 2 = MSB) where 000 = MANUAL (factory default); 001 = ANC; 010 = ANV; 011 = MAN CLOSED; 100 = ANV CLOSE D; 101 = REMOTE
- Bit 3** Control status where 0 = Off (local control); 1 = On (REMOTE control)
- Bit 4** Laser On/Off status where 0 = Off; 1 = On
- Bit 5** Gate pull up/pull down status where 0 = pull down; 1 = pull up (factory default)
- Bits 6-7** PWM frequency (Bit 6 = LSB; Bit 7 = MSB) where 00 = 5 kHz (factory default); 01 = 10 kHz; 10 = 20 kHz

Read Status Byte2 as follows:

- Bit 0** Lase on power-up status where 0 = No (factory default); 1 = Yes
- Bit 1** Maximum PWM percentage status where 0 = 99%; 1 = 95% (factory default)
- Bits 2-3** Reserved
- Bits 4-7** Software version number (Bit 4 = LSB; Bit 7 = MSB)

Read PWM and Power bytes as follows:

The reply, ranging from 00h to C6h, indicates a PWM percentage between 0–99% expressed in hexadecimal format. Convert the hex byte to decimal and then divide by two (a PWM percentage return of 7Bh equals 123/2 which equals 61.5%). The returned PWM Byte is equivalent to the commanded PWM duty cycle percentage shown in the LCD display.

In closed loop mode, the PWM Byte returns the commanded SET value, and the Power Byte returns the actual regulated POWER shown in the display. Power bytes are valid only when operating the UC-2000 in MAN. CLOSED or ANV CLOSED closed loop modes.

Note: The UC-2000 can report its status to the RS-232 link while in any operating mode.

Upgrading Your Existing UC-2000 Controller

For those customers already using REMOTE serial commands who want to implement the revised transmission protocol, an upgrade kit is available. This kit contains a new firmware (microprocessor) chip and instructions for removing/replacing the existing microprocessor chip inside the UC-2000 Controller.

Note that this upgrade chip is labeled v2.3 because the update to version 2.4 also coincided with a hardware change in all UC-2000 Controller's manufactured after November 2010. Contact your SYNRAD Regional Sales Manager for details and pricing on the UC-2000 v2.3 Upgrade Kit.

The following numbered steps and illustrations will guide you through the UC-2000 firmware upgrade. This upgrade involves replacing the UC-2000 microprocessor with a replacement microprocessor pre-programmed with firmware version 2.3.

Step 1 – Gather the Required Tools

To perform the chip removal and replacement, you will need the following tools:

- a Phillips head screwdriver
- a PLCC extraction tool or scribe

Caution: The microprocessor chip is sensitive to electrostatic discharges. These discharges may damage the chip. Perform the following steps in a static-free environment using an anti-static mat and/or a snug-fitting wrist strap or similar grounding method.

Step 2 - Record the Configuration Settings of Your Controller

- 1 With power applied to the Controller, press *Enter* and *Select* buttons simultaneously to enter the setup mode.
- 2 Record your current configuration settings for FREQUENCY (PWM frequency), GATE (gate logic), MAXIMUM PWM (maximum PWM percentage), and LASE ON PWR-UP (lase on power-up).

Step 3 - Open the UC-2000 Controller Housing

- 1 Disconnect all power and control cables from the UC-2000 Controller, then place it upside down on an anti-static work surface.
- 2 Remove the four Phillips head screws securing the rubber feet and bottom cover to the Controller housing.
- 3 Figure 1 shows the Controller with the bottom cover removed.



Figure 1 - View of control board mounted inside the Controller housing

Step 4 - Locate and Remove the Microprocessor Chip

The microprocessor chip, U2, is a Plastic Leadless Chip Carrier (PLCC) type.

- 1 Refer to Figure 2 and note the location of microprocessor chip (U2) and the chip extraction slots located on diagonal corners of the chip socket.



Figure 2 – Detail of chip extraction slots

Note: Do not damage the chip socket while removing the chip! If the chip socket is damaged, the circuit board will require replacement.

- 2 If you are using an extraction tool, follow Steps A and B below. If using a scribe or similar tool, proceed to numbered Step 3.
 - A Place the prongs of the extraction tool into the extraction slots of the chip socket.
 - B Grip the microprocessor chip firmly with the extraction tool while carefully lifting it from the chip socket.
- 3 If using a scribe or similar tool, follow Steps A through E below.
 - A Place the scribe tip into one of the extraction slots, pressing it against the bottom edge of the chip.
 - B Gently pry up the corner of the chip, lifting the chip one-third to one-half of the way out of the socket.
 - C Place the scribe tip into the other extraction slot, pressing it against the bottom edge of the chip.
 - D Again, gently pry up the corner of the chip, lifting it one-third to one-half of the way out of the carrier.
 - E Repeat Steps A through D until the microprocessor chip is free of the chip socket.

Step 5 - Install the New Microprocessor Chip

The new microprocessor chip is labeled with the software version V2.3.

- 1 Locate the bag containing the new microprocessor chip. Remove it from the bag while observing proper anti-static handling precautions.
- 2 Refer to Figure 3. Note that the microprocessor chip is positioned so that the bevel on the chip matches the bevel on the outer edge of the chip socket.



Figure 3 – Detail of bevels on chip and chip socket

Caution: Make sure the chip is oriented properly before inserting it into the chip socket. An improperly oriented chip may damage the microprocessor or the circuit board.

- 3 Refer again to Figure 3 and position the microprocessor chip over the chip socket while verifying that the bevel on the chip matches up with the bevel on the chip socket.
- 4 Apply an even pressure with your thumb and press the chip down into the socket until it snaps into position. Do not allow the chip to become cocked or wedged inside the socket.
- 5 Press firmly on each side of the chip to ensure that the chip is fully seated into the chip socket.

Step 6 - Close the UC-2000 Controller Housing

- 1 Position the bottom cover over the Controller housing.
- 2 Reattach and tighten the four Phillips head screws fastening the rubber feet and bottom cover to the Controller housing.

Step 7 - Reconfigure the Controller

- 1 Reconnect the Power/Control cable to the UC-2000 and apply power (15-50 VDC).
- 2 The startup screen should appear as shown in Figure 4.



Figure 4 – UC-2000 startup screen

- 3 Press *Enter* and *Select* buttons simultaneously to enter the setup mode.



- 4 Reconfigure the Controller to the settings you recorded earlier. If necessary, refer to the *UC-2000 Laser Controller Operator's Manual* for information on setup parameters.
- 5 Select "SAVE AND EXIT" to exit the setup mode and write operating parameters to memory. The Controller will beep twice to indicate that operating parameters were saved.
- 6 Reconnect all other control cables to the UC-2000 Controller.
- 7 Verify proper operation of the UC-2000 Universal Laser Controller.

This completes the microprocessor removal and replacement procedure. Please contact SYNRAD's Technical Support Department at 1-800-SYNRAD1 if you have any questions about this procedure.

For further information contact SYNRAD at 1.800.796.7231; outside the U.S., dial +1.425.349.3500 or fax us at +1.425.349.3667.