MACHINE SOLUTIONS INC.

USER MANUAL

VelaTechnologies
3D UV curing solutions

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WELCOME

Thank you for purchasing your new VelaCure. At Machine Solutions Inc. (MSI), we are dedicated to bringing innovative process development solutions to both medical device and nonmedical organizations. MSI looks forward to helping your organization provide life-improving devices to your customers, today and tomorrow.

MACHINE DESCRIPTION

The VelaCure3D is a three-dimensional curing system; engineered and designed to cure devices with UV-cured coatings. The VelaCure3D chamber produces extremely uniform irradiation on the parts being cured, resulting in uniform cure of all surfaces on the part. No rotation of the part or light source is required. The VelaCure3D cures all the surfaces, at once. The uniformity allows precise knowledge of the irradiance on the part during cure. Prior to the VelaCure technology, only the exitance from the light guide could be measured; the irradiance on the part could only be inferred. This is a revolution in 3D curing, providing you with confidence that your parts are being cured consistently and completely.

The included user interface is a simple and user-friendly touch screen control panel. The VelaCure3D can be configured with discrete and serial communications for remote interface with an external logical controller. After initial setup of the machine, the touch screen interface lamp and run controls can be disabled to prevent accidental exposures or lamp state changes from the touch screen. There are two exposure modes: TIME and DOSE. In DOSE control mode, the VelaCure uses a VelaRad or UV Sensor, to monitor the chamber irradiance and to achieve the user-input dose exposure for products in the chamber until the user-input dose (in J/cm^2) has been reached. If for any reason, the chamber irradiance declines, the VelaCure will extend the exposure time to compensate for the loss of irradiance. This ensures a consistent curing cycle exposure after exposure. In TIME mode, the exposure runs for the user input time.

The VelaCure can be configured with a calibrated VelaRad, or uncalibrated UV Sensor. The VelaRad is a calibrated device with the configurability of a UVA, or UVB control band, and/or a secondary UV band for reference.

Due to the variety of VelaCure models offered, some photos may not match your version.

SAFETY

Warnings, Cautions, and Notes used in this guide have the following meanings:

WARNING: Indicates procedure or situation that may result in injury or death if instructions are not followed.

CAUTION: Indicates procedure or situation that may result in damage to equipment or property if instructions are not followed.

NOTE: Emphasizes important information.

Interlocks

In general, VelaCure units must be installed inside an interlocked enclosure. This interlocked enclosure must be supplied by the customer and is necessary to protect individuals from exposure to hot surfaces, UV radiation, pinch points and other equipment dangers. Contact Vela if you need to operate the system outside of an interlocked enclosure.

When the UV lamp is on, UV radiation will be present within the system and some UV light may leak from the various joints and seams; this is normal and is not hazardous.

The VelaCure system itself does not have a safety-rated interlock system. A user-supplied safety interlock may be wired into the lamp external interlock input to force the lamp off if the interlock is broken. Refer to the lamp manual. Note that this will only stop the lamp producing UV light; it does not interrupt lamp ac power.

Microwave powered UV lamp systems may have been supplied with your system. These will include an RF detector/interlock that will shut the lamp down in the event of a microwave leak.

Some Vela systems are supplied with LED powered lamps. These systems do not use microwave energy and do not include an RF detector. Caution must be used with LED lamp powered systems to avoid exposure to UV radiation and/or intense visible light.

WARNING: Do not bypass the interlocks. The lamp RF detector interlock must be installed and connected.

High Voltage

High voltage is present inside the lamp power supply and lamp heads when powered on. Do not open the lamp power supplies or lamp heads while they are operating.

Do not disconnect the lamp head high voltage cable while the lamp is on. Do not open a lamp power supply without first unplugging the ac power and waiting at least 3 minutes.

WARNING: High voltage is present inside the lamp power supplies and lamp heads. Consult the lamp operating manual.

High Temperature

The lamp, light shield, choke (if applicable) and shutter operate at high temperature. Do not touch them during operation. Allow them to cool completely before servicing.

WARNING: The lamp and chamber shutter operate at high temperature. Allow them to cool completely before touching.

UV Radiation

The VelaCure system produces UV radiation during operation. Eye and skin damage may result from viewing direct or reflected UV radiation. Always wear proper UV protective equipment when operating the VelaCure system. Always wear UV protective eyewear and gloves.

WARNING: UV radiation may be present inside the VelaCure chamber when the connected lamp is energized. Wear proper protective equipment to shield eyes and skin from UV exposure. Never look directly into the lamp when on. Never open any access door when the shutter is open.

Ozone

Ozone may be present in the lamp exhaust and in the chamber when the lamp is on and the shutter is open. The lamp exhaust should be ducted outside of the workspace.

WARNING: Ozone may be present in the lamp and chamber exhaust during operation. Lamp cooling exhaust should be ducted outside of the workspace.

Microwave Radiation

The lamp is powered by microwave energy. It is shielded to prevent leakage of microwaves into the environment. Do not operate the lamp if the lamp housing or RF screen is damaged.
The lamp system is interlocked with an RF detector to sense microwave leakage before it reaches dangerous levels. However, you should never turn the lamp system on if the screen is damaged or not installed. Refer to the lamp manual for more information.

WARNING: Microwave radiation is generated when the lamp head is producing light. Do not operate the lamp with a damaged or missing RF screen. Do not tamper with, move or remove the RF detector mounted on the VelaCure chamber. Refer to the lamp manual for more information.

Mercury

The UV bulb provided with this system contains mercury. Dispose of it in accordance with federal, state and local regulations.

WARNING: The included bulb contains mercury. Dispose of bulbs in accordance with federal, state and local regulations. See the lamp manual for more information.

UTILITIES

The following utilities are required

Electrical

F300 lamps

Each lamp requires 200 – 240 VAC, ~3.2 kVA, single phase with ground. The power supplies are not auto ranging so must be configured for input voltage and frequency to be used. We have supplied them configured for 208 VAC, 60 Hz. Consult lamp manual to change these settings. See F300 lamp manual for detailed specifications.
Input AC current for each voltage setting (with integral blower lamp heads) are:
200 V input: 16 A
208 V input: 15.5 A
220 V input: 14.5 A
230 V input: 13.5 A
240 V input: 13.5 A

LH6-MKII lamps

Each lamp requires 200 – 480 VAC, ~2.5 kVA, three-phase. The power supplies are auto ranging. See LH6 Mark II manual for detailed specifications.

CW-306 lamps

Each lamp requires 200/210/240 VAC, ~3.5 kVA, single phase with ground. The power supplies are not auto ranging so must be configured for input voltage and frequency used. See CW-306 lamp manual for detailed specifications.

CW2-410 lamps

Each lamp requires 400/480 VAC, ~13.0 kVA, three-phase. The power supplies are not auto ranging. See CW2-410 lamp manual for detailed specifications.

AC8 lamps

The SC3000 power supplies require 200 – 220 VAC, 50/60 Hz, ~3.1 kVA, with an integral circuit breaker rating of 16A. See SC3000 manual for detailed specifications.

Chamber

Chamber controller requires 24VDC, 1A at connector J201 of HMI enclosure. The connector is supplied. It is a three-pin connector. Connect the outer two pins to ground and the middle pin to +24VDC.

Pneumatics

Shutters require pneumatic air.

The shutter is pneumatically driven. Use 80 – 100 psi clean dry air. Tubing, 6mm in diameter, is provided on the rear of the chamber. Unpressurized shutters may open and reduce chamber performance.

Lamp Cooling

Lamp heads require cooling to operate properly.

Lamp cooling air

If included, the integrated blowers of the Heraeus lamp heads will supply sufficient cooling air, this air must also be exhausted out of the facility due to ozone exposure risks. The VelaCure exhausts this air out of the light shield assembly. Air flow is approximately 100 cfm per lamp.

AC8 cooling air

Integral fans provide cooling of the AC8 lamp heads. These fans draw ambient air from the end and exhaust it out the side. There is no need to duct the exhaust out of the room, and there is no heat or UV exposure issue at the exhaust ports. Make sure not to block the exhausts.

SYSTEM OVERVIEW

The following describes important parts of your VelaCure system.

Chamber

The chamber dimensions (W x D x H) are defined by part quantity and irradiance. The chamber can be customized to accommodate specific product handling and accessories.

Power

Connect 24VDC to the J-box (or HMI enclosure as appropriate). See Section for the wiring diagram. This is for control power only; it does not supply power to the lamp(s).

Part Entry

This is designed to allow customer parts to enter and exit the chamber for UV curing. Depending on your system, this custom feature may be designed for manual or automated opening and closing. It may or may not interface with your automation.

Shutter

The pneumatic shutter is mounted directly on the chamber. This controls entry of light into the chamber. It is either fully closed or fully open. The shutter cannot be opened unless the carrier is present and all VelaCure interlocks are satisfied.

Choke

An optional choke is available. This is a manually adjustable aperture to provide 10 different irradiance levels in the chamber. It is most convenient with fixed power lamps. It mounts directly to the shutter.

Light Shield

The light shield adapts the lamp to the chamber/shutter/choke assembly and directs lamp cooling exhaust air into an integrated 3" diameter exhaust duct, preventing lamp air entering the chamber.

ControlCure System

This is a 4.3" touch-screen user interface. Refer to Page 58 User Interface.

Microwave Lamp

This system is compatible with F300 or LH6 lamps from Heraeus, and CW306 or CW2-410 lamps from Nordson. All of these lamps mount directly to the chamber light shields.

If your microwave lamps were provided by Vela, they have been prepared for remote operation and the RF detector has been installed on the chamber. The lamp front panel indicators operate but the

buttons are inoperable. Do not change this configuration. If you purchased your lamp separately, you must configure them as described in the wiring diagram.

LED Lamp

LED powered chamber systems are compatible with various manufacturers of LED lamps.
If your LED lamps were supplied by Vela, they have been prepared for remote operation by the Vela controller. Do not change this configuration. If you purchased your lamps separately, you must configure it as described in the wiring diagram and lamp manual.

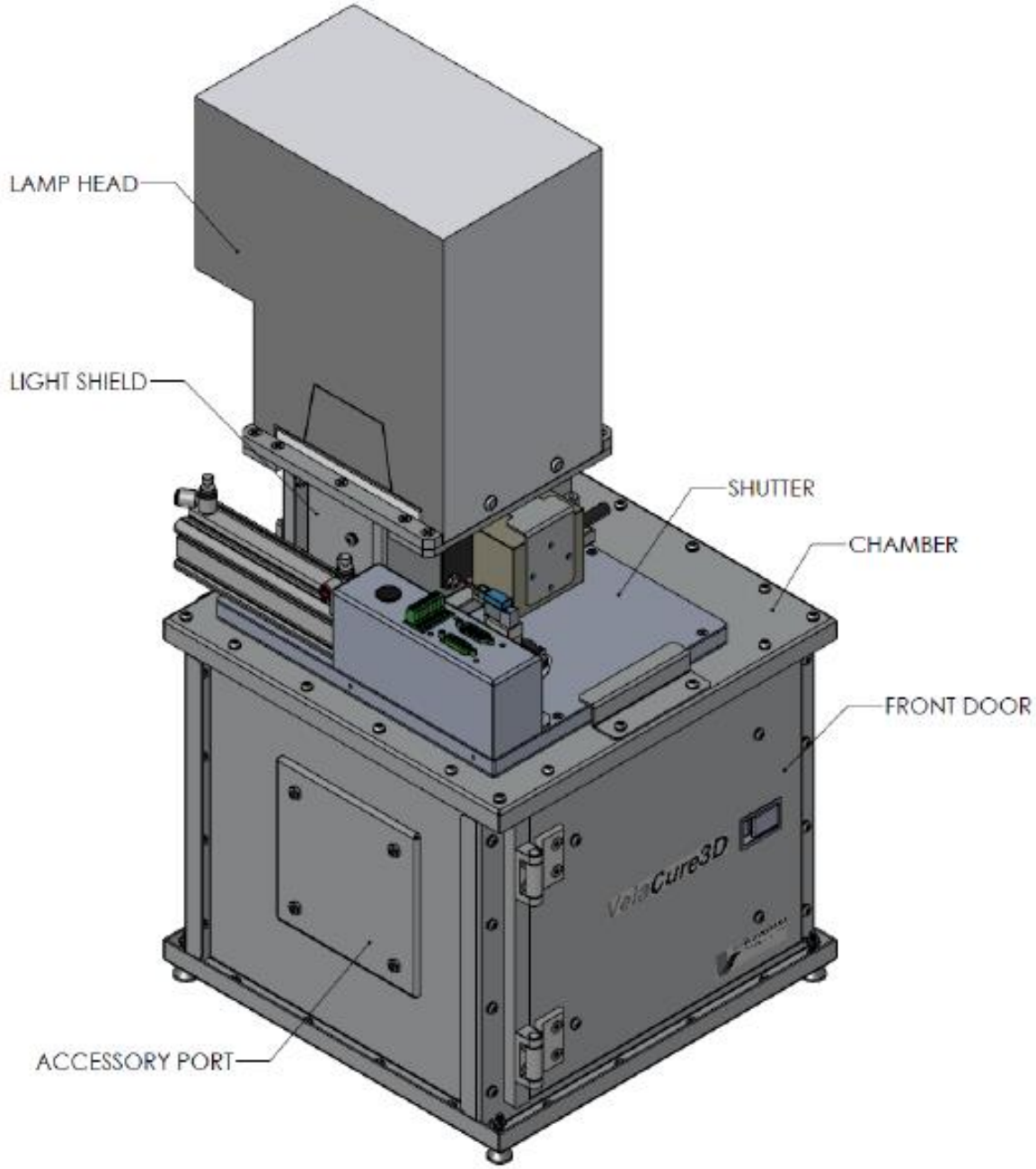


Figure 1. VelaCure System

NOTE: HMI not shown. Shown with F300 lamp, supplied separately.

MECHANICAL INSTALLATION

Unpacking

Carefully unpack the chamber, lamp heads, lamp power supplies and accessories. Remove packing material from inside the light shield. You shall find:

- Chamber assembly
- HMI assembly
- Drip pan(s)
- Chamber control cables

Chamber

Place chamber assembly on bench or table. Allow sufficient space in front to open door. Connect DC supply to HMI enclosure J201 to power the chamber.

Use 6mm tubing to connect pneumatic air to the chamber at rear. This is used to drive the shutters. See section below for utility requirements.

Microwave Lamps

These lamp systems comprise of lamp power supply, lamp head, RF interlock, and interconnecting cables. The lamp head has the option for an integral cooling blower. Refer to lamp manuals for more details.

Microwave Lamp Power Supplies

Each power supply has been configured by Vela as either Master or Slave and labeled appropriately.

The AC power connector is included. You must mount this connector on your power cord to supply power to the power supply.

Install each power supply with at least 8 inches clearance on front and back for proper cooling. We recommend stacking the power supplies one atop the other.

See section below for utility requirements.

The lamp power supplies must be configured for remote operation prior to use. Figure 2 shows the proper settings. With these settings, the front panel indicators will work but the controls will be disabled. Refer to the lamp manual for more details.

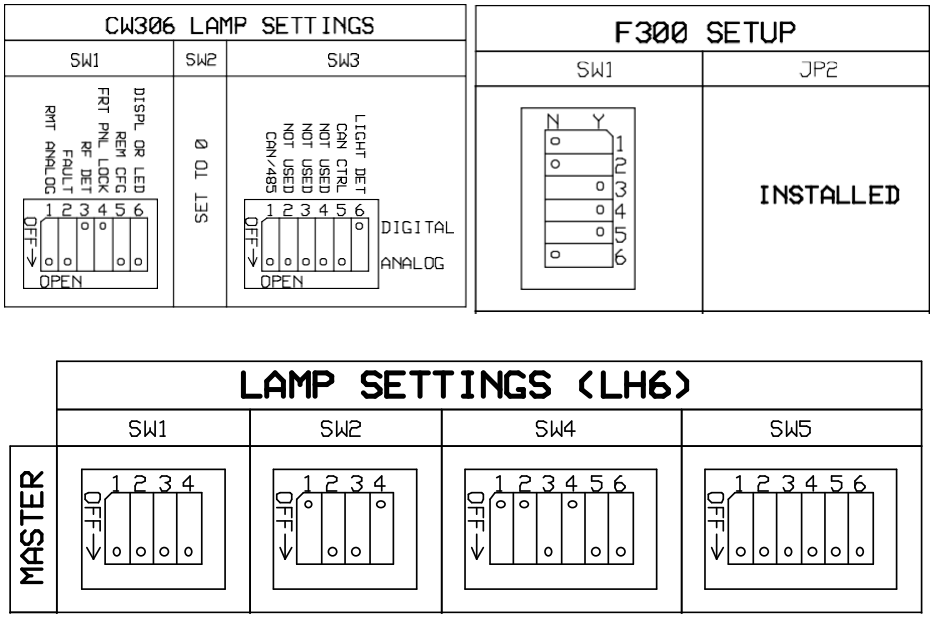


Figure 2. Lamp Configuration Settings
Top left, CW306; top right, F300; bottom, LH6 (legacy model). Does not apply to LH6 Mark II. Consult lamp manual for details.

Microwave lamp heads

Remove the lamp port covers if installed.

For microwave powered UV lamps, consult the lamp manual for lamp setup and connection. The lamp head must be mounted to the chamber light shield. Place the lamp head on the light shield and secure using the captive thumbscrews. If it is vertically mounted, it may rest on the light shield with no other support. You must provide lamp head support for horizontal installations.

CAUTION: You must provide support for horizontally mounted lamp heads.

RF interlock

Its function is to shut off the lamp in the event of microwave leakage. It cannot be bypassed.

For microwave powered UV lamps, the RF detector mounts on a bracket either on the light shield or chamber. For Heraeus UV lamps, remove the bar supplied with the detector and install the detector on its mounting bracket so the detector face, as described in the lamp manual, points toward the light shield. Route the cable away from the shutter cylinder.

Cabling

The system will have supplied cables: lamp control, HV, blower, Master/Slave interface, Profibus interface, and RF. In addition, since the RF interlock must be connected to the Master supply, a terminator is provided for the Slave RF interlock connector. All connectors are keyed and sexed to prevent misconnection. Refer to the labels on each cable end.

Connect these cables as shown in the electrical schematics.

The RF interlock must be connected to the Master power supply connector, or power supply that corresponds to the lamp the RF detector is installed on.

Lamp Exhaust

The microwave lamp heads can include integral cooling blowers. These draw room air to cool the lamp head. Cooling air flows over the lamp bulb and into the light shield where it is diverted to a 3" exhaust duct on the light shield. The exiting air is ~70C and contains ozone, so it must be exhausted outside.

Use common techniques to reduce exhaust back pressure. The exhaust run should be as short as possible. Use smooth sided ducting that can withstand the temperature. Minimize bends and maximize bend radii.

In addition, we recommend using a 90 metal elbow connected directly to the light shield exhaust adapter. The UV and visible light intensity is substantial at the exhaust adapter; the 90 bend will eliminate line of sight. Furthermore, this high intensity light will rapidly degrade non- metallic ducting material.

WARNING: Exhaust ducting will be hot, especially near the light shield. Intense UV/VIS radiation will be present in exhaust connector if ducting is not installed when operating. Intense UV/VIS radiation will be present at unused lamp ports during operation. Unused lamp ports must be covered during operation.

AC-8 lamps

Each AC8 lamp system comprises a power supply, lamp head and interconnecting cables. Refer to the electrical schematics for interconnections. No RF interlock is required for AC8 lamps. Refer to AC8 lamp manual for more details.

AC8 power supply

We have supplied Excelitas OmniCure SC3000 power supplies for the AC8 lamp heads. There is no configuration required on these power supplies. While the SC3000 supplies can drive up to four lamp heads, you should connect only one lamp head to each supply.

See section below for utility requirements.

AC8 lamp heads

Remove the lamp port safety covers if installed. Use the pre-installed side mounts to secure the lamp heads to the lamp ports.

Cabling

Connect the supplied lamp head power cables between the power supply and lamp heads. Take note of the labels on the cables to make sure lamp heads are properly connected.

Connect the control cable as shown in the electrical schematic.

ELECTRICAL INSTALLATION

This section describes only the electrical installation that must be performed by the user. Do not disturb cables and wiring already installed on the system.

NOTE: The following describes Vela's standard electronics architecture. Some systems may have custom electronics package on the chamber. In this case, connector names and types will generally be the same but may be located differently. Refer to the wiring diagram.

Chamber Power

Connect 24VDC to the chamber system as described in the wiring diagram using a shielded cable.

Lamp Power

Connect the lamp power supply to your ac circuit per the lamp manual. The power requirements are given in the lamp manual. Refer to the lamp manual for instructions on configuring the power supply for the voltage and frequency you will use.

CAUTION: You must ensure the lamp power supply is configured for the voltage and frequency you will be using. Refer to the lamp manual.

Irradiator

Connect the high voltage cable between the lamp and irradiator according to instructions in the lamp manual. Ensure the high voltage cable is well tightened.

If you are using an integral blower lamp head, connect the blower cable between the lamp power supply and irradiator.

RF Detector

Connect the RF detectors to the correct connector on the lamp power supplies. Refer to the lamp manual.

Lamp Remote Control

The lamp control cable for Hereaus lamps has a D-sub connector on the VelaCure end and a CPC-37 connector on the lamp end. Connect it between the VelaCure system J205 and the lamp power supply control jack.
For Nordson CW306 lamps supplied by Vela, the control cable is already terminated using connectors supplied with the lamp. Refer to the wiring diagram if Vela did not supply the lamp.

Chamber control

Connect the supplied DB15 M/F cable between HMI J203 (DB15-F) and the chamber (DB15-M). The cable is polarized so it cannot be misconnected.

Radiometer Control

Connect the supplied Ethernet cable between the radiometer, mounted on chamber, and the HMI enclosure J210 (RJ45).

Remote Control

Connect your cable between your PLC and the HMI enclosure J204 (DB25-F).

Serial control

If configured for serial control, connect an Ethernet cable between VelaCure and your PLC, or the adapter cable between the ethernet cable and your PLC. Refer to the electrical schematics.

PNEUMATIC CONNECTIONS

The shutter requires 80 – 100 psi air. Do not exceed 100 psi.
Connect supply air to the pneumatic connection on the chamber (6mm or 8mm, depending on model; see wiring diagram).

LAMP HEAD COOLING AND EXHAUST

No lamp cooling air enters the chamber.

Supply

Consult the lamp manual for cooling supply requirements.

Note: Not all Heraeus lamp heads will include integrated blowers.

Exhaust

Lamp cooling air exhausts through the integrated exhaust plenum or through the individual 3" diameter duct adapter(s) on the light shield(s). Connect your cooling air exhaust ducting to this port. Use oversized, smooth-wall ducting with minimal bends to avoid restricting the flow of air out of the light shields. The exhausted air will be hot.

Very intense UV and visible light shines out of the light shield exhaust port. Therefore, do not operate the unit without ducting attached to the light shields such that it prevents direct and indirect exposure to exiting light. There is no interlock to detect presence of exhaust ducting.

The lamp may generate ozone during normal operation. If so, ozone will be present in the exhaust air. It will be present in the chamber only when the shutter is opened.

WARNING: Never operate this unit without lamp and chamber exhaust ducting attached to prevent UV and ozone exposure. Route exhaust ducting out of the work space.

Bulb Cool Down

For best results, allow the bulb to cool completely before turning off the lamp cooling air. See your lamp manual.

Nordson CW306 lamp automatically starts a 60 second cool-down period every time the lamp is turned off. This is indicated by a rapidly flashing "Off/Reset" LED on the lamp power supply front panel. During this time, the lamp cannot be turned on and the VelaCure controller will be in the Lamp Cool Down state. Note that this only applies after the lamp turns off – usually due to a fault – and not at the end of a normal run. The VelaCure controller will ignore RUN commands during this cool-down period.

CHAMBER HEATING

If so equipped, you may flow heated air through the chamber. Do not exceed 85 C air.

PART ENTRY

Systems with a simple opening for your parts are designed to accept user-supplied part carrier. The carrier must be in position before beginning an exposure to avoid excess light leakage.
If your system is supplied with a pneumatic part entry door, you must still present your parts to the chamber using a carrier or other automation. A sensor will detect presence of the carrier. If it is not present, a run cannot be started. Do not remove the carrier until Run Complete is received by the PLC; otherwise, a fault will occur.

REMOTE CONTROL

The VelaCure remote interface, if ordered, has two manifestations: basic, with only a digital interface; and advanced, with the digital interface augmented by serial interface. This section describes both.

PLC Discrete Interface:

Inputs and Outputs

Refer to **Table *2*. VelaCure status bitmap**, **Table *3*. Vela Protocol Frame Format**, and **Figure *1*. VelaCure System**

Outputs from VelaCure are solid state contact closures, sourced by PLC at 24V, <30mA DC. Inputs to VelaCure must be contact closures, sourced by VelaCure at 24V, 5mA DC.

All PLC outputs should be pulsed with 0.2 – 1.0 second duration except Lamp Enable (see below).

STOP must be unasserted (open) at power up and before sending START.

Unlike the other PLC inputs, LAMP ENABLE must be held asserted (or unasserted), not pulsed. It is only evaluated in Ready, Waiting and Lamp Disabled states and is ignored in all other states.

The target value via discrete control is only active if the VelaCure system is not configured for serial interface (see below). The discrete I/O is set by the PLC using a 6 bit value (DOSE_0 thru DOSE_5). Target dose output must be stable before START command is sent; it will be evaluated by VelaCure immediately after START is received. It will be ignored at all other times.

Target dose range must be set using VelaCure HMI via the Settings screen. Values for target minimum value (corresponding to Dose_0 through Dose_5 = 000000) and maximum value (corresponding to 111111) must be set manually at the VelaCure HMI.

If the VelaCure system is configured for serial interface when delivered, then the target value must be set using the serial interface or locally at the Vela HMI. DOSE_0 thru DOSE_5 are not active in this case.

Lamp Enable

When Lamp Enable is asserted, the lamps will make light if there are no faults present. When unasserted, the lamps will be in "Standby" state, ready to make light. It may be held asserted during lamp and VelaCure power on if desired.

Unlike the other PLC inputs, LAMP ENABLE must be held steady, not pulsed. It is only evaluated in Ready, Waiting and Lamp Disabled states and is ignored in all other states.

Lamp Enable should not be used as an E-STOP or part of a safety interlocking scheme.

The serial Lamp Enable command is ignored if this discrete Lamp Enable is activated (see VelaCure Serial Interface Protocol for details).

System Status

VelaCure status is indicated by a bitmap detailed in **Error! Reference source not found.**. All states a re reached automatically in response to the system state and PLC commands (except Calibration).

Handshaking

Do not send outputs from the PLC unless VelaCure is in the proper state for that output:

- START: VelaCure must be in READY or CAL READY status before sending START.
- STOP: VelaCure must be in RUNNING status before sending STOP.
- ACKNOWLEDGE: VelaCure must be in RUN COMPLETE or CHAMBER FAULT status before sending ACKNOWLEDGE.
- LAMP ENABLE: VelaCure must be in Ready, Waiting or Lamp Disabled states for changes in LAMP ENABLE to take effect; it is ignored in all other states. When the lamp is disabled, VelaCure will be in Lamp Disabled state.
- If VelaCure is in WAITING, CAL WAITING or LAMP DISABLED do not send a command other than LAMP ENABLE.

Furthermore, verify the status changes to the expected state after sending a command:

- START should be followed by RUNNING status.
- STOP should be followed by CHAMBER FAULT status.
- ACKNOWLEDGE should be followed by WAITING or READY status.
    - LAMP ENABLE should be followed by WAITING or READY status.

Check the VelaCure HMI if the proper status is not received.

Lamp Control

The lamp configuration will determine how the lamps are controlled.

- *Master/Slave discrete control (Heraeus F300, LH6 Legacy, LH6 Mark II; Nordson CW306).* If the lamps are configured for Master/Slave operation, all lamps on the VelaCure system will operate together and at the same power. All front panel controls on the lamps are disabled, but front panel indicators remain enabled. ControlCure will bring the lamp(s) to their on state (making light) automatically. They will remain on unless a fault is present or Lamp Enable is unasserted.

Certain faults will cause the lamps to turn off (not make light). Once the fault is cleared, the lamps will turn on automatically if Lamp Enable is asserted.

ControlCure does not interrupt lamp AC power; it only controls the lamp state.

For Nordson CW306 only. When the CW306 lamp turns off, it cannot be turned on until a 60 second cool-down period has expired. This is indicated by the flashing "reset" LED on the lamp power supply. The controller will not try to restart the lamp until this time has expired.

- *Lamp serial interface (Heraeus LH6 Mark II only).* LH6 Mark II lamps may be operated in Master/Slave or Profibus mode. If configured and used for Profibus control, each lamp may be controlled independently. In this configuration the lamps are controlled via serial interface. See the serial interface specification for details.

  Note: Discrete Lamp Enable must still be asserted even when using LH6 Mark II in Profibus mode.

Shutters

If multiple shutters are installed, they will all operate together.

Part entry door (optional)

All part entry doors will operate together. The doors will be open in any state but RUNNING, when they will be closed. Shutters must be closed for doors to operate.

Integrated part position sensing by VelaCure is optional. If not provided by Vela, VelaCure assumes the part is in place when START is received. If provided by Vela, the part must be in place to reach READY state; if the part position is lost during a run, a CHAMBER FAULT is declared.

Clamshell chambers only

Part position and chamber closed sensors must be provided by the customer. It is the customer's responsibility to ensure the parts are in place and the clamshell is closed prior to sending START. Clamshell articulation must be provided by the customer.

Initial power up sequence

It is essential that STOP be unasserted during VelaCure power up.

Once the VelaCure power up sequence is complete, the system will report WAITING or READY as appropriate. When in WAITING, it will not respond to START. Once the VelaCure system is ready, VelaCure will indicate READY status and an exposure may begin. Asserting START (when in READY) will cause an exposure to begin immediately.

If START is asserted at completion of power up, a run will automatically begin.

Configurables

Certain controller settings may be set by the user. Access these via the System Settings screen.

- Lamp type
  Select F300, LH6 (Standard), LH6 (H+), LH6-MkII, CW306, or CW2-410 as appropriate. LH6 (H+) should be used only if an H+ bulb is installed in an LH6 lamp. Factory configuration: per order.
- Disable buttons
  When selected, the Run and Disable Lamp buttons in the Ready screen are disabled (gray, inactive). This is to prevent inadvertent operation when using remote control. Factory configuration: not selected.
- Enable Cal PW
  If selected, the operator password must be entered before a calibration can be performed. If not selected, no password is needed to calibrate. Factory configuration: selected. Not active when using VelaRad.
- Auto-Run
  If selected, an exposure will start as soon as all conditions are met (e.g., doors closed, part in place) with no user intervention. Factory configuration: per order.
- Set Cal. Time
  If selected, the duration of the calibration exposure will always be the value displayed, which may be changed by the user. If not selected, the calibration exposure time will be the same as the most recent regular run. Factory configuration: selected, 11 sec. Not active when using VelaRad.
- Slave ID
  If serial option is enabled, set the VelaCure address here.
- Baud
  If serial option is enabled, set the baud rate for PLC communication here.
- Power
  Set lamp power during exposure ("Full Power") and at all other time ("Idle Power") here. Only active if variable power lamp is selected. Idle is limited to 60% when LH6 (H+) is selected. Factory defaults: Full = 100%, Idle = 60%.

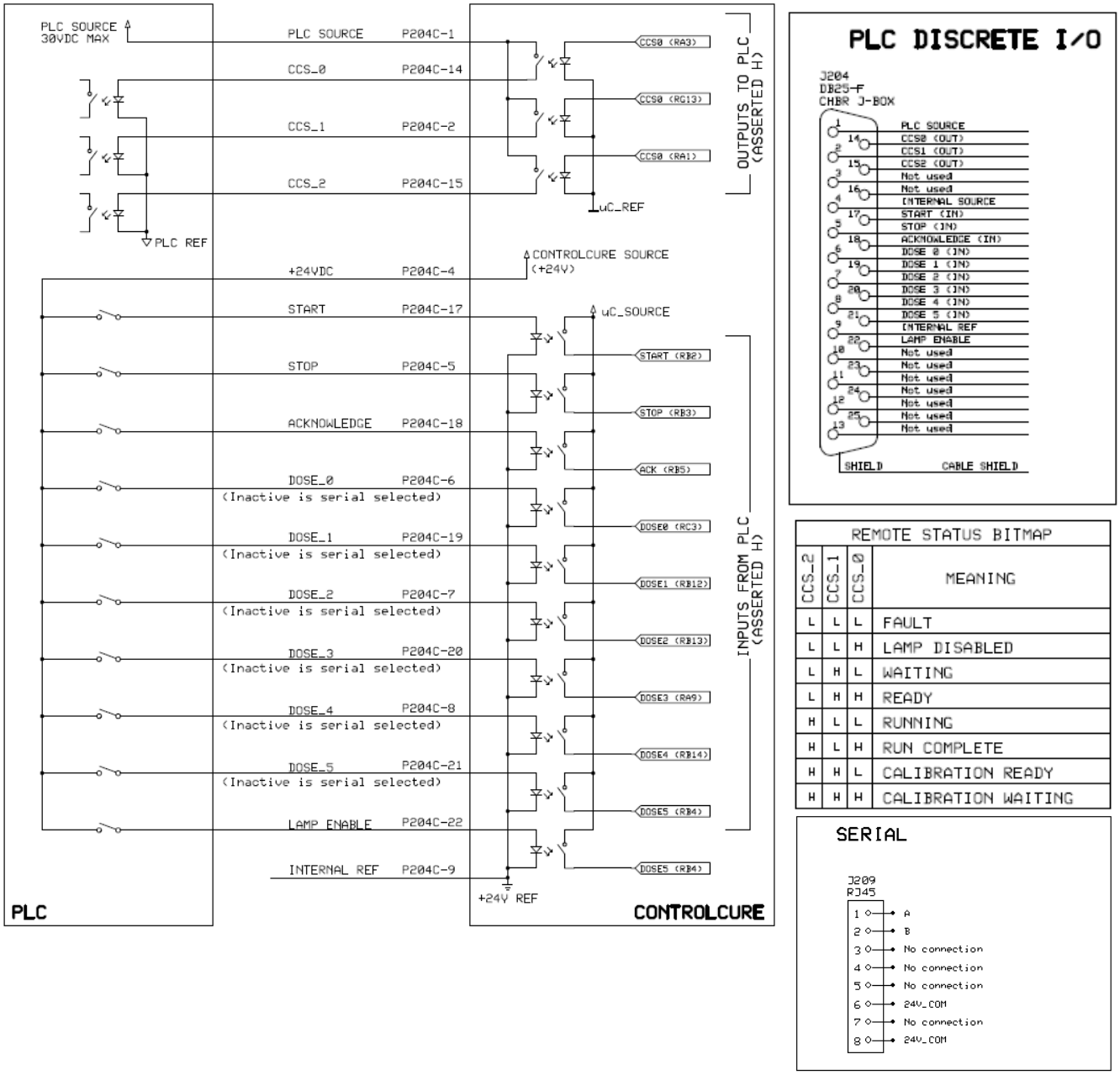
Table 1. List of chamber I/O. Dose_0 is the remote target least significant bit (LSB)

Inputs to VelaCure	
Name	**Meaning**
START	Begin a cure cycle if STOP is unasserted. *Must be unasserted at power up.*
STOP	Stops a cycle in progress or prevents a cycle from starting. If asserted in Ready state, will go to Waiting state. *Must be unasserted at power up.*
ACKNOWLEDGE	Acknowledges and clears popup screens and faults.
LAMP ENABLE	When asserted, the lamp will make light if no faults are present. Is evaluated only in Ready, Waiting and Lamp Disabled states.
DOSE_0 through DOSE_5	6-bit input target (time or dose). DOSE_0 is the LSB. Value is read immediately after RUN asserts; ignored otherwise. *Not active if PLC Serial coms are used.*

Outputs from VelaCure	
Name	**Meaning**
CCS_0 through CCS_2	Bitmap indicating status of VelaCure unit. See **Table *2.* VelaCure status bitmap**

Table 2. VelaCure status bitmap

STATUS BIT			NAME	MEANING
CCS_2	**CCS_1**	**CCS_0**		
0	0	0	Chamber Fault	A fault condition exists. Once the fault is cleared, assert ACKNOWLEDGE to exit the fault state.
0	0	1	Lamp Disabled	The lamps have been disabled.
0	1	0	Waiting	Chamber cannot run due to non-critical error (e.g., an interlock is open)
0	1	1	Ready	All is ready to start an exposure.
1	0	0	Running	An exposure is underway.
1	0	1	Run Complete	An exposure has completed. Assert ACKNOWLEDGE to exit Run Compete state.
1	1	0	Calibration Ready	Ready to perform calibration exposure.
1	1	1	Calibration Waiting	In Calibration mode, but a non-critical error exists (e.g., an interlock is open)



REMOTE STATUS BITMAP			
CCS_2	CCS_1	CCS_0	MEANING
L	L	L	FAULT
L	L	H	LAMP DISABLED
L	H	L	WAITING
L	H	H	READY
H	L	L	RUNNING
H	L	H	RUN COMPLETE
H	H	L	CALIBRATION READY
H	H	H	CALIBRATION WAITING

Figure 3. I/O diagram, interface pinouts and status bitmap

PLC Serial Interface:

Digital I/O

Even with Serial Interface active, the VelaCure system status requires digital (discrete) communication I/O for status and control functions.

Serial Settings

- Fixed Settings-
  These serial settings for the Vela Serial Interface are fixed and cannot be changed:
  - Stop Bits: 1
  - Parity: None
  - Flow control: None
  - Data bits: 8

- Variable Settings-
  These values may be changed in Main Menu→System Settings→More.
  - Vela default address: 05
  - Vela default baud rate: 115200

  Full system testing has only been performed using a baud rate of 115200. Other supported bad rates of 9600 and 3200 have been tested using basic commands only. It is highly recommended that a baud rate of 115200 be used. In the event that 115200 cannot be used the system should be tested and qualified using the desired supported baud rate.

Serial Data Protocol: Overview

The serial protocol used for the Vela interface is named Vela Protocol and is fully defined in the following sections. The transport layer used for the Vela protocol is RS-485 half-duplex and is fully described in the RS-485 specification.
The Vela Protocol is based on a fixed frame sized design with either 9 or 11 bytes depending on whether or not a checksum is used. The frame format is defined in **Error! Reference source not found.** below.
All communication must be initiated by the external controller. The Vela system acts only as a Slave.

Table 3. Vela Protocol Frame Format

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
D	R	T	C	0x d5 d4 d3 d2 d1	Cs2 Cs1

- Destination Address (Byte 1)
  This is the node ID of the node for whom the message is intended.
  Any value in the range 0x00 – 0xFF (0-255) is valid but it must correspond to a node on the serial network.

- Broadcast Address
  Address 0x0B is reserved as a broadcast address. Any interested node can read these messages. Broadcast capability is reserved for future use and is not currently implemented.

- Return Address (Byte 2)
  This is the ID of the node that sent the message, generally the controlling PLC.

- Message Type (Byte 3)
  There are three message types:
  - Update (0x02)
    An Update message tells the node to do something that results in a lasting change to the node itself, for example requesting the target node to change the target setpoint. An Update message is always acknowledged by the target node with a Reply message containing the same register code and data to verify that the correct value was received. Only the Master can send an Update message.
  - Request (0x03)
    A Request message asks the target node to send some data back to the requester, for example a request for the value of the current target setpoint. A Request message does not result in a lasting change to the node itself. After receiving a Request message, a node will send back a Reply message with the requested data.
    Only the Master can send a Request message.
  - Reply (0x04)
    A Reply message is a response to either an Update or Request message. A Reply message will contain the same register code as the message it is replying to, except in the case of a com error when it will reply with the Com Error register code and data reflecting the error that occurred. Reply messages will only be sent by Slave nodes and should never be sent by the Master controller.
    Only the VelaCure system can send a Reply message.
- Register Code (Byte 4)
  The Register Code defines what register is acted upon.
  A single Register Code can be associated with multiple Message Types. For example, the "Target Setpoint" Register Code can accompany Update, Request and Reply message types. Target Setpoint *Update* is a message telling the node to update its Target Setpoint to the value sent; Target Setpoint *Request* is a request for the node to reply with its current Target Setpoint; and Target Setpoint *Reply* is a reply (from the node to the master) to either of the two previously described messages.
  Each individual message code has its own interpretation of the 5-byte data payload.
  Register codes and their data are listed in Table 4 with extensive explanation in Section 0.

- Data (Bytes 5 – 9)
  Data bytes are values sent by the originating node or returned by the Vela controller in response to requests. Update commands must include the value for updated parameter

here. Data bytes will be ignored by the Vela controller for request commands, (still, we recommend using zeros in each byte for request commands). Generally, these are hex values but the specific command determines the format.
Refer to **Table *4*. Register Codes and Data Format**.

- Checksum (Byte 10)
  Checksum is not implemented in this revision. It is included here to describe the planned implementation. The Example Transactions section assumes Fletcher-16 checksum.

Serial Data Protocol: Details

This section provides details of every aspect of the serial data protocol.

- Register Codes and Data Format
  Table 4 and following sub-sections give a description of each register code with its meaning, associated data format.

Table 4. Register Codes and Data Format

Code (C)	***Meaning***	***Valid Message Types[1]***	***Data (5 bytes, XXXXX)[2]***
0x01	Target Setpoint	Update Request Reply	Target Setpoint is target value of exposure dose (J/cm^2) or time (seconds). Upon receiving Start command, VelaCure will conduct an exposure until the Target Setpoint has been reached. Format is 0x 3x 3x 3x 3y 3y, where: • All values "x" are ASCII representations of numbers • Decodes as xxx.yy with units of J/cm^2 or seconds, depending on target type selected • Example: 0x 31 32 33 34 35 = 123.45
0x02	Target Type	Update Request Reply	Target Type sets the units of Target Setpoint (Dose = J/cm^2, Time = seconds). Format is 0x 00 00 00 00 TT, where TT indicates type: • TT = 01 is target type Time • TT = 02 is target type Dose • No ASCII here; these are actual numbers 0x00 = 0

[1] Indicates the type of messages that can be associated with this register, though not all will necessarily be used.
[2] All data values are represented as ASCII characters.

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0x03	Last Run Dose, Primary Band[3]	Request Reply	Returns primary band dose from last exposure in J/cm^2. Two formats are available: ASCII or floating point; selection is in Factory Setup screen as "Serial FP." Format with "Serial FP" selected is 0x xx FPByte4 FPByte3 FPByte2 FPByte1, where: • FPByte* is a 4-byte hex representation of an IEEE 32-bit floating-point value • xx = don't care • Example: 0x 00 42 F6 E6 66 = 123.45 J/cm^2 Format with "Serial FP" not selected is 0x XX XX XX XX XX, where: • All values of "XX" are ASCII representations of numbers • Example: 0x 31 32 33 34 35 = 123.45 J/cm^2
0x04	Last Run Exposure Time[3]	Request Reply	Primary band exposure time from last exposure in seconds. Two formats are available: ASCII or floating point; selection is in Factory Setup screen as "Serial FP." Format with "Serial FP" selected is 0x xx FPByte4 FPByte3 FPByte2 FPByte1, where: • FPByte* is a 4-byte hex representation of an IEEE 32-bit floating-point value • xx = don't care • Example: 0x 00 42 F6 E6 66 = 123.45 seconds Format with "Serial FP" not selected is 0x XX XX XX XX XX, where: • All values of "XX" are ASCII representations of numbers • Example: 0x 31 32 33 34 35 = 123.45 seconds

[3] Last run data (dose, average irradiance, exposure time) is deleted at beginning of next run.

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0x05	Last Fault Code	Request Reply	Returns hex code for last fault. *NOTE: Fault code is cleared when Acknowledge is received while in fault state, even if fault condition still exists.* Format is 0x 00 00 00 00 FC, where: • FC is fault code in hex; see fault codes, Table 5 • Example: 0x 00 00 00 00 07 = Run Cancelled by User fault
0x06	Reset Lamp[4]	Update Reply	Resets all lamps and starts automatic lamp-on routine of the selected lamps. Replies with COM Error if one or more lamps fail to respond Format is 0x xx xx xx xx xx, where xx = don't care
0x07	Disable HMI Buttons	Update Request Reply	Disables Run and Reset Lamp buttons on HMI, preventing accidental operation. Format is 0x 00 00 00 00 DB, where DB indicates selection: • DB = 00 means Enable Buttons, or Buttons Are Enabled • DB = 01 means Disable Buttons, or Buttons Are Disabled
0x08	Serial Number	Request Reply	Returns VelaCure system serial number. Serial number has a max of 7 characters. Data Format is 0x 00 00 00 00 00, using hex bytes The first hex data byte represents ASCII text, the next four hex data bytes represent a decimal value. To decode the serial number: separate the first hex data byte and convert to ASCII text. Convert the next four hex data bytes into a decimal number. Then combine into one string value. • Example: 0x 46 00 01 E2 40 is serial number F123456 On systems updated to firmware versions 8.24.0 and higher or all firmware versions below 8.24.0: Serial number is 5 characters. Format is 0x 3x 3x 3x 3x 3x, using ASCII formatted hex bytes, • Example: 0x 31 32 33 34 34 is serial number 12345

[4] Only valid in lamp disabled state.

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0x09	Firmware Version	Request Reply	Returns VelaCure firmware version. Last three data bytes are MajorRev MinorRev Patch. Format is 0x 00 00 XX YY ZZ, using ASCII formatted hex bytes, where XX = MajorRev, YY=MinorRev, XX=Patch • Example: 0x 00 00 08 0E 03 is version 8.14.3
0x0A	Cal Factor	Request Reply	Returns VelaRad calibration factor. Reply is a 4-byte representation of an IEEE 32-bit floating-point value. Format is 0x xx FPByte4 FPByte3 FPByte2 FPByte1, where: • FPByte* is a 4-byte representation of an IEEE 32-bit floating-point value • For example, 0x 39 01 73 F8 = 1.23456e-4 (= 0.000123456)
0x0B	Cal Date	Request Reply	Hex coded day month year in dd/mm/yyyy format. Format is 0x xx DD MM YY YY • Example: 0x 08 0C 07 E6 is 08/12/2022 or 12 AUG 2022
0x0C	UV Band	Request Reply	Returns which UV bands are detected by primary and secondary detectors. Primary band is always installed; secondary band is optional. Format is 0x xx xx SecBand PriBand, where • PriBand and SecBand are hex 0x41, 0x42, 0x43 representing UVA, UVB, or UVC bands respectively • SecBand = 0x00 means no secondary band is installed • Example: 0x 00 00 00 43 41 = UVC Secondary band; UVA Secondary Band

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0x0D	Lamp Fault Code[5]	Request Reply	Returns the detailed fault code for the specific lamp requested. The fault code itself is hex, 2-bytes. See lamp fault codes, Table 6, and discussion, Section ?. Format for Request data: 0x xx xx xx xx LampID, where: • LampID = Lamp address • xx = don't care Format of Reply data: 0x xx xx HiByte LoByte LampID, where: • LampID = Lamp address • LoByte = low byte of fault code in hex • HiByte = high byte of fault code in hex • xx = don't care • Example: 0x 00 00 00 21 0B = Lamp 10 has fault code 33 (Cable Interlock Fault)
0x0E	Selected Lamps	Update Request Reply	Selects which lamps in multiple lamp system will be used. Data bytes are a 2-byte bitmap for up to 10 lamps. *NOTE: Lamps will turn off when this command is sent, resulting in a Lamp Fault (depending on context). Reset Lamps must be sent after changing Selected Lamps.* *NOTE: Lamp 1 must always be selected.* Format is 0x xx xx xx BM1 BM2, where: • BM2, BM1 form a 16-bit bitmap with LSB = bit 0 of BM1 • Map: bit 0 = lamp 1, bit 1 = lamp 2, bit 2 = lamp 3, bit 3 = lamp 4, bit 4 = lamp 5, etc. • Example: All lamps enabled = 0x 00 00 00 03 FF • Example: Only Lamp 1 enabled =0x 00 00 00 00 01

[5] Lamp fault code is 16-bit value so two bytes are used here; see Lamp Fault Code table below.

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0x0F	Lamp Run Power Level	Update Request Reply	Sets lamp power to be used during exposure ("Run Power"). For variable power lamps only. All lamps in multiple lamp systems use same run power setting. Format is 0x 00 00 00 00 RunPwr, where: • RunPwr is hex representation of lamp power percentage during run • Example: 0x 00 00 00 00 64 = 100% power during run • Example: 0x 00 00 00 00 4B = 75% power during run • Example: 0c 00 00 00 00 32 = 50% power during run
0x10	System Status Bits	Request Reply	Returns detailed system status in a four byte bitmap. See status bitmap, Table 7. *NOTE: For troubleshooting only. Consult Vela before using this feature.* Format is 0x xx Byte4 Byte3 Byte2 Byte1
0x11	Lamp Power State[6]	Update Request Reply	Immediately changes lamp power setting from Idle to Run, or from Run to Idle. Intended to warm lamp to Run Power level prior to starting exposure. Only for variable power lamps. *NOTE: Exposure must start within 15 seconds of changing to Run Power level to avoid fault.* Format is 0x xx xx xx xx PwrSt , where • PwrSt = 01 Run Power level • PwrSt = 00 Idle Power level
0x12	Ping	Request Reply	Ping request and reply. Establishes communication with Vela controller is working. Format is fixed at 0x 68 65 6C 6C 6F (hex for ASCII "Hello") for request and reply.

[6] Lamp power state can only be set with system in Ready State; see discussion below.

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0x13	Lamp Idle Power Level	Update Request Reply	Set lamp power to be used during idle periods, that is, when an exposure is not underway. All lamps in multiple lamp systems use same idle power setting. For variable power lamps only. Value is typically 60% and should not exceed 65%. Format is 0x 00 00 00 00 IdlePwr, where: • IdlePwr is hex representation of lamp power percentage when in idle • Example: 0x 00 00 00 00 3C = 60% power at idle
0x14	Do Not Use	--	--
0x15	Acknowledge	Update Reply	Handshake; send this code to exit Fault or Run Complete states. Clears popups on Vela HMI. Data bytes are ignored. Format is 0x xx xx xx xx xx, where xx = don't care
0x16	System State, Detailed	Request Reply	Returns the detailed system state. See Table 8. *NOTE: For troubleshooting only. Consult Vela before using this feature.* Format is 0x xx xx xx xx SS, where SS is the current system state in hex
0x17	Last Run Average Irradiance, Primary Band[3]	Request Reply	Average primary band irradiance during last exposure in W/cm^2. Two formats are available: ASCII or floating point; selection is in Factory Setup screen as "Serial FP." Format with "Serial FP" selected is 0x xx FPByte4 FPByte3 FPByte2 FPByte1, where: • FPByte* is a 4-byte hex representation of an IEEE 32-bit floating-point value • For example: 0x 42 F6 E6 66 = 123.45 W/cm^2 Format with "Serial FP" not selected is 0x XX XX XX XX XX, where: • All values of "XX" are ASCII representations of numbers • For example: 0x 31 32 33 34 35 = 123.45 W/cm^2

Code (C)	Meaning	Valid Message Types[1]	Data (5 bytes, XXXXX)[2]
0x18	Last Run Average Irradiance, Secondary Band[3]	Request Reply	Average secondary band irradiance during last exposure in W/cm^2. Two formats are available: ASCII or floating point; selection is in Factory Setup screen as "Serial FP." Format with "Serial FP" selected is 0x xx FPByte4 FPByte3 FPByte2 FPByte1, where: • FPByte* is a 4-byte hex representation of an IEEE 32-bit floating-point value • For example: 0x 42 F6 E6 66 = 123.45 W/cm^2 Format with "Serial FP" not selected is 0x XX XX XX XX XX, where: • All values of "XX" are ASCII representations of numbers For example: 0x 31 32 33 34 35 = 123.45 W/cm^2
0x19	Last Run Dose, Secondary Band[3]	Request Reply	Secondary band dose from last exposure in J/cm^2. Two formats are available: ASCII or floating point; selection is in Factory Setup screen as "Serial FP." Format with "Serial FP" selected is 0x xx FPByte4 FPByte3 FPByte2 FPByte1, where: • FPByte* is a 4-byte hex representation of an IEEE 32-bit floating-point value • For example: 0x 42 F6 E6 66 = 123.45 J/cm^2 Format with "Serial FP" not selected is 0x XX XX XX XX XX, where: • All values of "XX" are ASCII representations of numbers For example: 0x 31 32 33 34 35 = 123.45 J/cm^2
0x1A	Lamp Enable	Update Request Reply	Enables or Disables lamps from making light. This command has the same effect as pressing the Enable Lamp button on Vela HMI, and is valid only when that button is shown on the screen. This command is not allowed if the discrete Lamp Enabled I/O line is selected in the Factory Setup screen. Format is 0x xx xx xx xx XX, where • XX = 01 Enables Lamp (or, Lamp Is Enabled) • XX = 02 Disables Lamp (or, Lamp Is Disabled)

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0x1B	Radiometer Serial Number	Request Reply	Note: Radiometer serial numbers were updated to include seven characters. The firmware versions did not change, and the format remains the same. Refer to the Radiometer engraved serial number to use correct method. If the serial number is under seven characters: Returns the radiometer serial number as a 32-bit integer value in little endian format. Format is 0x xx byte4 byte3 byte2 byte1 • Example: 0x 00 00 00 00 4D = radiometer serial number 77 If the serial number is seven characters: The hex bytes will need to be converted into a 32-bit integer. The first two digits of the integer need to be separated and converted into ASCII text. Then combine the ASCII text into one string value with the rest of the integer values. • Example: 0x 00 04 2D FF C0 converts to a 32-bit integer value of 70123456. The radiometer serial number will then be F123456.
0x1C	Radiometer Version	Request Reply	Returns VelaCure firmware version in format MajorRev.MinorRev.Patch Format is 0x XX 2E YY 2E ZZ, using ASCII formatted hex bytes: • Example: 0x 08 2E 0C 2E 05 is version 8.12.5 • NOTE: 2E = ASCII "dot"
0x1D	Radiometer Temperature	Request Reply	Returns radiometer PCB temperature as a 4-byte representation of an IEEE 32-bit floating-point value. Format is 0x xx FPByte4 FPByte3 FPByte2 FPByte1, where: • FPByte* is a 4-byte hex representation of an IEEE 32-bit floating-point value • For example: 0x 42 0A 45 6D= 34.5678 C

Code (C)	*Meaning*	*Valid Message Types[1]*	*Data (5 bytes, XXXXX)[2]*
0xFF	Com Error	Reply	When returned, indicates something went wrong with communications. See Com Error Code Table 9. Format is 0x 00 00 00 00 XX, where XX is the com error code.

Discussion of Selected Transactions

- Last Run Data (0x03, 0x04, 0x17, 0x18, 0x19)
  Various data from the last run can be retrieved. Run data registers are cleared at the beginning of the next run, so after a run has started all Last Run Data is lost.
  Primary band is the band used for dose control; secondary band is not used for control and is for information only.
  - Dose, Primary Band (0x03)
    This is the total accumulated primary band dose reached during the most recent successful exposure. Units are J/cm^2.
  - Exposure Time (0x04)
    This is the total exposure time. It is the same for both bands. Units are seconds.
  - Average Irradiance, Primary Band (0x17)
    This is the Last Run Dose Primary Band divided by Last Run Time. Units are W/cm^2.
  - Average Irradiance, Secondary Band (0x18)
    This is the Last Run Dose Secondary Band divided by Last Run Time. Units are W/cm^2.
  - Dose, Secondary Band (0x19)
    This is the total accumulated secondary band dose reached during the most recent successful exposure. Units are J/cm^2.
- Last Fault Codes (0x05)
  Fault codes describe problems with the system itself and are sent in reply to a "Last Fault Code" request. Fault Code is cleared when Acknowledge is received while in fault state. The definitions of all available fault codes are given in Table 5 below.

Table 5. General Fault Codes

Fault Code (XXXXX)	Fault
0x 00 00 00 00 01	Interlock Open
0x 00 00 00 00 02	UV Sensor Saturated
0x 00 00 00 00 03	Shutter Failure
0x 00 00 00 00 04	Door Failure
0x 00 00 00 00 05	Shutter Overheated
0x 00 00 lampBM2 lampBm1 06	Lamp Fault (LampBm1 and LampBm2 are faulted lamps bitmap). All lamps faulted lampBm1=lampBm2=0xFF, lamp2 only faulted lampBm2=0x00, lampBm1= 0x02
0x 00 00 00 00 07	Run Cancelled By User
0x 00 00 00 00 08	Low UV Output
0x 00 00 00 00 09	Unexpected UV Detected
0x 00 00 00 00 0A	Access Panel Open
0x 00 00 00 00 0B	Shutter Timeout
0x 00 00 00 00 0C	Door Timeout
0x 00 00 00 00 0D	Lamp Power-up Failure
0x 00 00 00 00 0E	Communication with LED Controller Failed
0x 00 00 00 00 0F	EEPROM Write Failed, Value Not Stored
0x 00 00 00 00 10	Radiometer Write Failed
0x 00 00 00 00 11	Lamp full power timeout
0x 00 00 00 00 12	General radiometer fault
0x 00 00 00 00 13	Low dose
0x 00 00 00 00 14	RCF out of range error
0x 00 00 00 00 15	Radiometer failed to start
0x 00 00 00 00 16	Radiometer over temperature
0x 00 00 00 00 17	Radiometer read error
0x 00 00 00 00 18	Radiometer stopped
0x 00 00 00 00 19	Radiometer failed to acknowledge run complete
0x 00 00 00 00 1A	Overdose reported by radiometer

- Lamp Fault Codes (0x0D) – LH6 MkII Only
  These fault codes relate to the lamps only.
  LH6 MkII lamps with serial interface can provide their fault code over the serial interface.
  Table 6 gives the description of the faults that may be reported by the lamp. You must request each lamp's fault code individually by specifying the lamp ID in this request.

Table 6. Lamp Fault Codes for LH6-MkII

Code (Hex)	Code (Dec)	Fault Description
0x00	0	No Fault
0x01	1	Mag Current High Fault
0x02	2	Not Used
0x03	3	Mag Current Low Fault
0x04	4	Not Used
0x05	5	Not Used
0x06	6	Power Supply Over Temp Fault
0x07	7	Power Supply Low Temp Fault
0x08	8	EEPROM Fault
0x09	9	Internal Fan Fault (total fans current)
0x0A	10	Air Pressure Fault
0x0B	11	RF Sensor Short Fault (RF Fault)
0x0C – 0x0D	12 - 13	Not Used
0x0E	14	Filament Current Low Fault
0x0F	15	Not Used
0x10	16	RMS Filament Voltage Low Fault
0x11	17	RMS Filament Voltage High Fault
0x12	18	Filament Current High Fault
0x13	19	Not Used
0x14	20	Mag Voltage High Fault
0x15	21	Mag Voltage Low Fault
0x16	22	RF Sensor Open Fault
0x17	23	Not Used
0x18	24	No Bulb Ignition Fault
0x19	25	Photo Detector Short Fault
0x1A	26	Photo Detector Open Fault (Lamp Out)
0x1B	27	E-Stop Fault
0x1C – 0x1D	28 - 29	Not Used
0x1E	30	Low Control Voltage Fault
0x1F	31	Communication Timeout Fault

Code (Hex)	Code (Dec)	Fault Description
0x20	32	Not Used
0x21	33	Cable Interlock Fault
0x22	34	RAM Fault
0x23	35	Not Used
0x24	36	Network Power Fault
0x25 -0x2B	37 - 43	Not Used
0x2B – 0x32	44 - 50	Reserved
0x33 – 0xC8	51 - 200	Engine Internal Faults
0xC9 – 0xFF	201 - 255	Not Used
0x100 – 0x15E	256 - 350	Not Used
0x15F – 0x1F4	351 - 500	Blower Module Internal Faults (Optional)
0x1F5 – 0x226	501 - 550	Dry-Contact MASTER/SLAVE FAULTS
0x227 – 0x258	551 - 600	Reserved
0x259 – 0x28A	601 - 650	Network FAULTS
0x28B – 0x2BC	651 - 700	USB FAULTS
0x2BD – 2EE	701 - 750	Internal Communication FAULTS
0x2EF – 0x320	751-800	Misc. FAULTS

- System Status Bitmap (0x10) – Troubleshooting Only

  A four-byte status bitmap is used to describe the status of the system. Each of the 32 bits in the bitmap describes a different status condition. A value of 1 indicates that the status is set while a value of 0 indicates that it is not. For example, if Byte #1 has a value of 8 it indicates that the photo sensor is currently in a saturated state. Not all status bits are relevant to every system. Refer to Table 7.

  Vela does not recommend using this function for routine or control operations. Many of these status values will be set or cleared rapidly; however, they can be used in special circumstances to gain more insight into what is happening in the system.

  NOTE: Consult with Vela before using this feature.

Table 7. System Status Bits

Bit number	Meaning when set
1	General interlock open
2	Cancel button pressed
3	Lamp output below minimum
4	Photo sensor saturated
5	Lamp off
6	Shutter open
7	Shutter closed
8	Shutter fault
9	Door open
10	Not used
11	UV above minimum
12	Door locked
13	Pressure Low
14	Part not positioned
15	Remote stop
16	Lamp delay on
17	Chamber open
18	Shutter temperature over maximum
19	Radiometer not ready
20	Current screen is not ready/waiting screen

- System State (0x16) – Troubleshooting Only

  The system states given in Table 8 below are essentially the same as those given by the status bits via the digital I/O interface. The difference is that the number of states that can be indicated by the three status bits is limited, so several states are combined into one.
  This code should only be used for debugging. For run control operations, the digital I/O status bits should be used.
  NOTE: Consult with Vela before using this feature.

Table 8. System State Codes

Code	CCS bitmap	State
0	001	Lamp Disabled
1	010	Waiting
2	011	Ready
3	010	Lamp Power Up
4	010	Lamp Warm Up
5	100	Shutter Opening
6	100	Running
7	100	Shutter Closing
8	101	Run Complete
9	000	Fault
10	100	Door Closing
11	100	Door Opening
12	010	Indexing In
13	010	Indexing Out

- Lamp Enable/Disable (0x1A)
  This should only be used when you wish to stop the lamp from making light for an extended period to save energy, for example during service on other parts of your machine.
  NOTE: Do not use this command for routine lamp on/off. Doing so will create many timing issues and unexpected behavior, as well as reduce lamp component lifetime.

- Com Error Codes (0xFF)
  Communication Error Codes describe errors that occurred during serial communication and are associated only with communication issues, not system faults.
  In the event that a received message cannot be interpreted correctly, a Com Error message will be returned. The type of the error can be determined by comparing the received error code to the descriptions given in Table 9.

Table 9. Communication Error Codes

Returned Com Data Bytes	Error
0x 00 00 00 00 01	Unknown message type (Byte 3)
0x 00 00 00 00 02	Unknown register code (Byte 4)
0x 00 00 00 00 03	Incomplete message (less than 9 bytes received). **NOTE: Return will be addressed to 0x00 since actual address may not be known.**
0x 00 00 00 00 04	Register invalid for this message type (Byte 3)
0x 00 00 00 00 05	Invalid type received (Byte 3)
0x 00 00 00 00 06	Lamp communication failed while attempting to retrieve requested data
0x 00 00 00 00 07	Radiometer communication failed while attempting to retrieve requested data
0x 00 00 00 00 08	Lamp communication in progress; PLC serial coms disabled.
0x 00 00 00 00 09	Register (Byte 4) invalid with the current factory setup.
0x 00 00 00 00 0A	Register (Byte 4) invalid in the current system state.

- Lamp Power State

  Certain lamps can have two defined power states, which are referred to as *Idle Power* and *Run Power,* each as a percent of lamp maximum power:

  - *Idle Power State* is used to reduce heating on chamber components when a run is not underway. Idle Power value is set using code 0x13. While the range is 35 – 65%, Vela recommends using 60% as the idle power setting.
  - *Run Power State* is used only when a run is underway. The lamp power is increased from idle to run power when a treatment cycle is initiated but prior to opening the shutter. Run Power value is set using code 0x0F.

  The transition from idle to run power can take several seconds, during which time the lamp output power and spectrum will vary. You can bring the lamp to stable run power before an exposure starts in one of two ways:

  - Using Pre-Start. Prior to sending Start, use the *Lamp Power State* update message (0x11). This raises the lamp power from idle to run power as soon as the command arrives. You must send the Start command within 15 seconds or the system will fault to prevent shutter overheating.
  - Using Lamp Delay. Set the Lamp Delay value in the Vela HMI (in Factory Screen; consult Vela. When value is non-zero, Lamp Delay is active. After Start is received, the Vela controller will change lamp power from idle to run power setting, but not begin an exposure. It will then countdown the value entered as the Lamp Delay variable. Once that time has expired, an exposure will start. This can only be set using the Vela HMI. The entered value must be 15 seconds or less. A value of 0 sec disables Lamp Delay.

Checksum

Checksum is not implemented in this revision. It is included here to describe the planned implementation. The Example Transactions Section below assumes Fletcher-16 checksum.

Example Transactions

The following are examples of how various transactions are performed. For all of the following it is assumed that the Master (PLC) node address is 0x01 and the Slave (Vela) node address is 0x05.
The examples below give valid checksums to help with algorithm validation. There are many resources available online which describe how to calculate the checksum.

- Update Target Setpoint
  In this example the Master node wants to change the Target Setpoint on the Slave to 23.75.
  - Update Packet
    The update packet is constructed and sent as follows:

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x05	0x01	0x02	0x01ss	0x 00 32 33 37 35	0xF5 0x34

- Reply Packet
  The Slave replies with the following reply packet:

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x01	0x05	0x04	0x01	0x 00 32 33 37 35	0xE4 0x41

- Request Current Target Setpoint
  Behold the Master requesting the current target setpoint from the Slave node.
  - Request Packet
    The request packet is constructed as follows (xx = don't care)

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x05	0x01	0x03	0x01	0x xx xx xx xx xx	May vary

  - Reply Packet
    The Slave replies with the following packet (assuming the set point is still 23.75)

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x01	0x05	0x04	0x01	0x 00 32 33 37 35	0xE4 0x41

- Update Target Type
  The following sequence shows the transaction when attempting to set the target type to dose.
  - Update Packet
    The following packet is constructed and sent.

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x05	0x01	0x02	0x02	0x 00 00 00 00 02	0xC0 0x36

  - Reply Packet
    The Slave replies with the following packet.

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x01	0x05	0x04	0x02	0x 00 00 00 00 02	0xB1 0x43

- Request Last Run Dose
  Here the Master is requesting the final dose from the last run.
  - Request Packet
    The request packet is constructed as follows (xx = don't care)..

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x05	0x01	0x03	0x03	0x xx xx xx xx xx	May vary

- Reply Packet
  The Slave replies with the following packet. Here, the actual dose was 23.50.

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x01	0x05	0x04	0x03	0x 00 32 33 35 30	0xE6 0x44

Com Error Sequence

The following sequence demonstrates a com error. In this case, the PLC attempts to write to a register that is read only and the Vela controller replies with a com error frame.

- Update Packet
  The PLC sends a packet that requests that the last run time be updated to 10.50 sec.

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x05	0x01	0x02	0x04	0x 00 31 30 35 30	0xFF 0x30

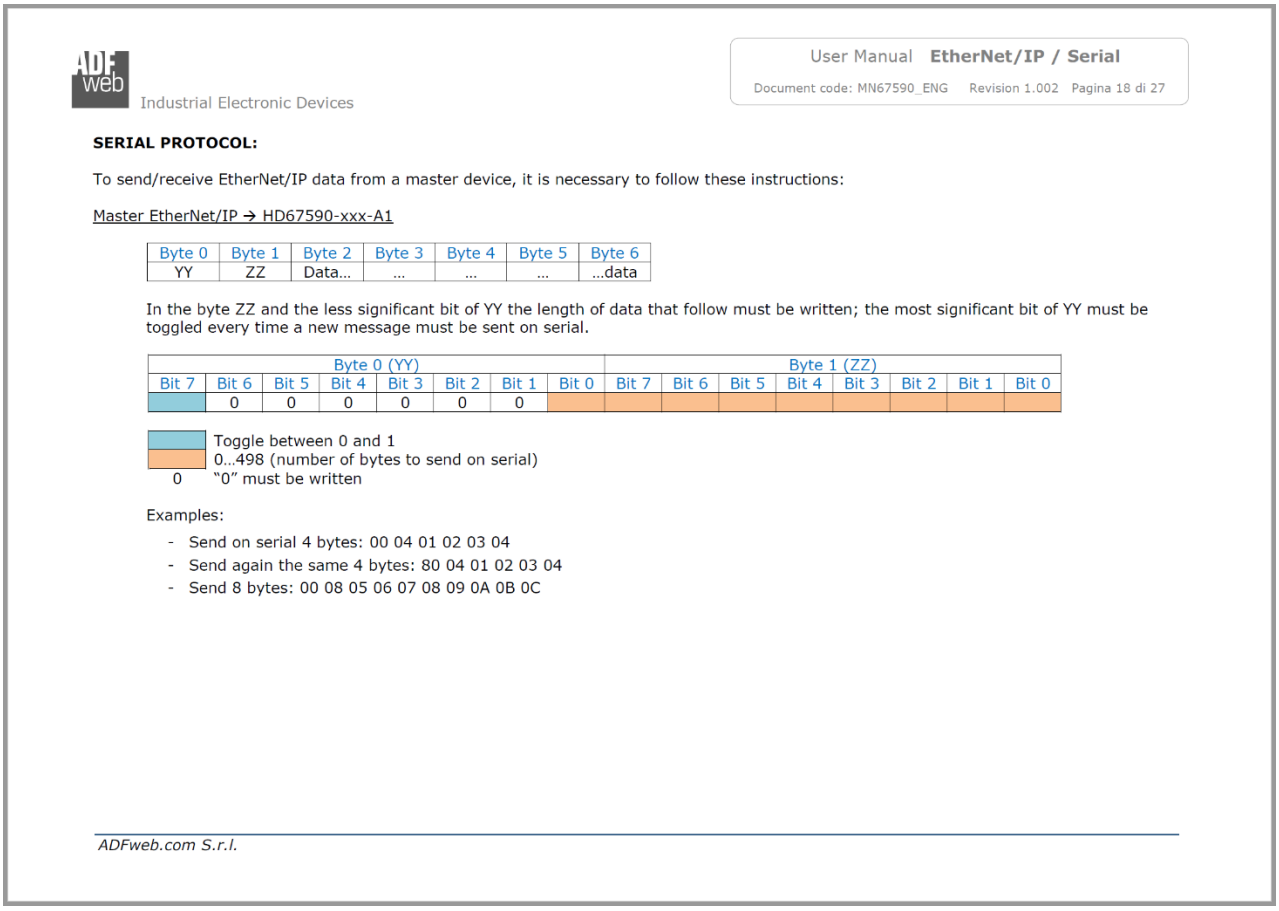
- Reply Packet

  The Slave replies with the following com error packet because an update to a non-updateable register is invalid.

Destination Address	*Return Address*	*Message Type*	*Register Code*	*Data*	*Checksum*
0x01	0x05	0x04	0xFF	0x 00 00 00 00 04	0xC6 0x2F

Use With Ethernet/IP Gateway

Vela offers an Ethernet/IP gateway as an option. If installed, the gateway is ADF Web part number HD67590-485-A1, an Ethernet/IP Slave, RS485 Master converter. The Vela-supplied gateway is configured prior to shipping using an IP address you provided.
The manual is available at http://www.adfweb.com/download/filefold/MN67590_ENG.pdf.
You will need to configure your PLC program according to pages 18 – 19 of the gateway manual. You will also find specific instructions for configuring it when using Rockwell RSLogix 5000 on pages 22 – 25. These are all reproduced here for your convenience.
If your system does not have Vela-supplied Ethernet/IP capability, disregard this section.



ADF web Industrial Electronic Devices

User Manual **EtherNet/IP / Serial**
Document code: MN67590_ENG Revision 1.002 Pagina 18 di 27

SERIAL PROTOCOL:

To send/receive EtherNet/IP data from a master device, it is necessary to follow these instructions:

Master EtherNet/IP → HD67590-xxx-A1

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
YY	ZZ	Data...	...	...	...	...data

In the byte ZZ and the less significant bit of YY the length of data that follow must be written; the most significant bit of YY must be toggled every time a new message must be sent on serial.

Byte 0 (YY)								Byte 1 (ZZ)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0									

Toggle between 0 and 1
0...498 (number of bytes to send on serial)
0 "0" must be written

Examples:

- Send on serial 4 bytes: 00 04 01 02 03 04
- Send again the same 4 bytes: 80 04 01 02 03 04
- Send 8 bytes: 00 08 05 06 07 08 09 0A 0B 0C

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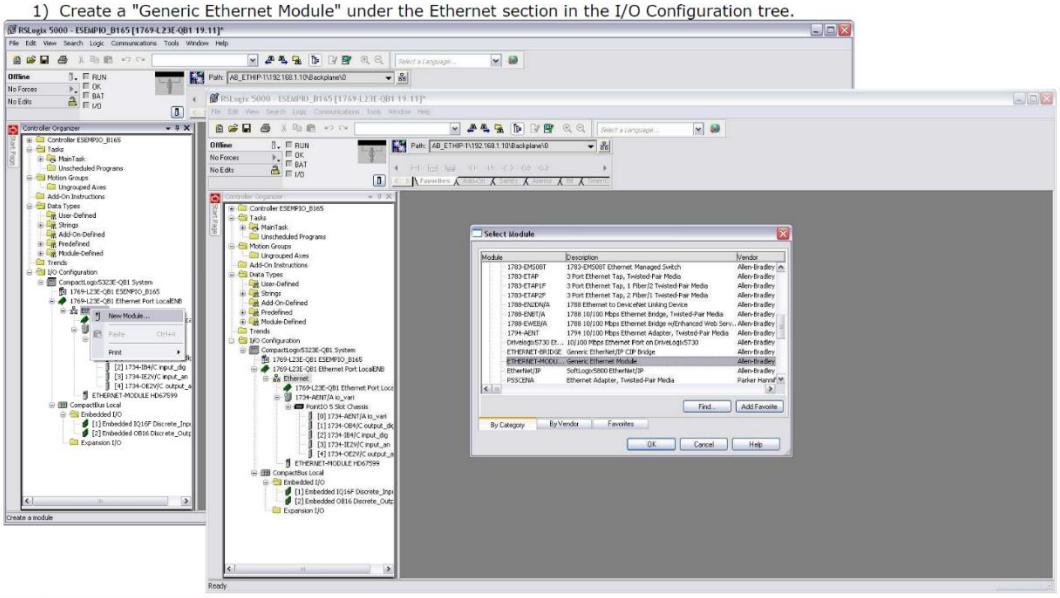
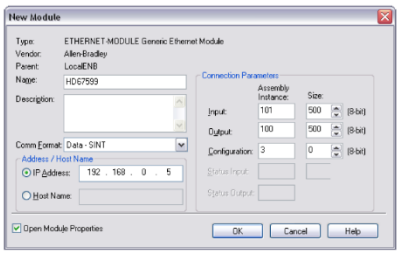
PLC CONFIGURATION:

The configuration and commissioning of the EtherNet/IP Converter as described on the following pages was accomplished with the help of the "RSLogix 5000" software of Rockwell Automation. In case of using a control system from another supplier please attend to the associated documentation.
These are the steps to follow:

1) Create a "Generic Ethernet Module" under the Ethernet section in the I/O Configuration tree.





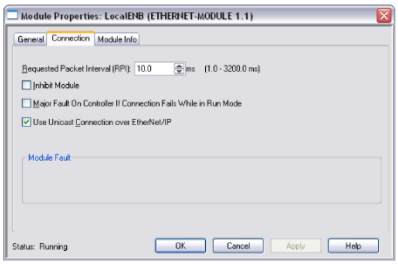
2) Edit the settings of the new Generic Ethernet Module. As shown in the screen shot below, the module was named "HD67590" and the IP-address assigned is 192.168.0.5.

For the Comm Format "Data – SINT" shall be selected as the data type.

The HD67590-xxx-A1 can uses up to 496 bytes for input assembly instance 101 and 496 bytes for output assembly instance 100.

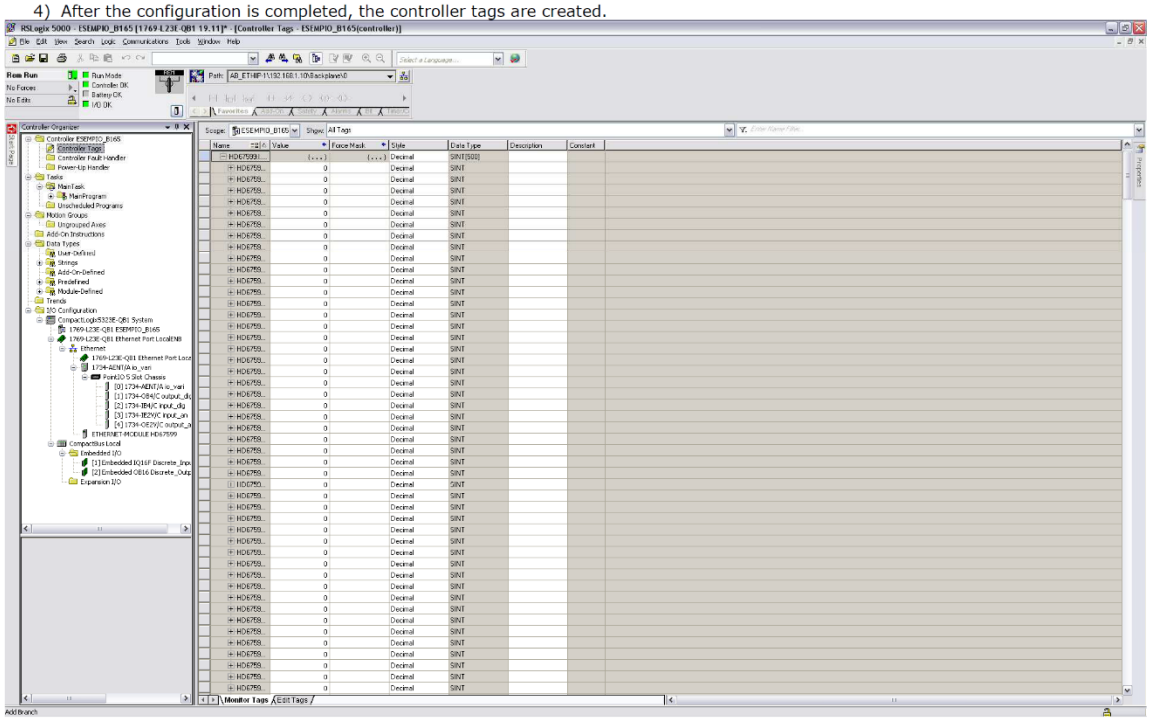
RSLogix 5000 requires a configuration assembly instance. Both modules do not provide a configuration assembly instance. Therefore it is allowed to select an instance of 3 and to set the value to zero.

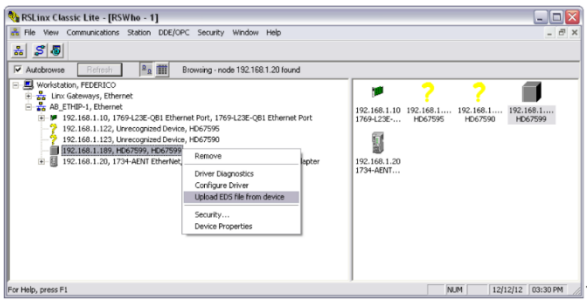
3) The setting of 10msec for the "Requested Packet Interval (RPI)" is adequate but it is possible to change this value as required. A lower value of 2ms shall not be selected.



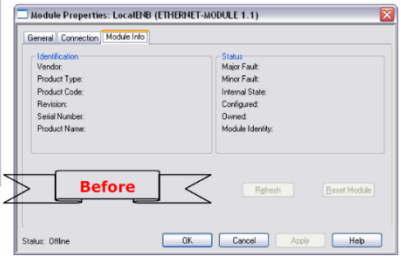
Warning:
The field "Use Unicast Connection over EtherNet/IP" must be checked.

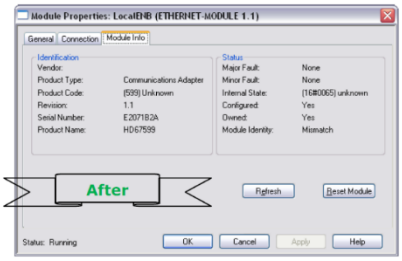
4) After the configuration is completed, the controller tags are created.





5) With "RSLinks Classic Lite", after have done a network scan (RSWho), and finding the EtherNet/IP device, it is possible to load the EDS file for the device in order to have the "Module Info" compiled.





USER INTERFACE

This section describes the user interface in general. Your system may contain newer features not described.

Overview

The user interface is a 4.3" touch-screen LCD display. Each screen is identified by a title bar across the top. The main portion of each screen (below the title bar) contains icons that are used to navigate among the various screens. The larger icons are active buttons; pressing them will bring up a new screen. The smaller icons across the top give status information.

Optional front panel user interface contains START/OK, STOP/CANCEL, RESET, and EMERGENCY STOP buttons.

Figure 4. Front Button Panel

The green START/OK button is used to start a run, and acknowledge popup screen status messages.
The red STOP/CANCEL button is used to stop a cycle in progress, or prevents a cycle from starting. Must be unasserted at power up.
The blue Reset button resets the safety relay after the E-Stop button has been pressed and cleared.
The Emergency Stop button asserts Lamp Enable low in Ready, Waiting, Lamp disabled, and Running states; which will disable the lamp. This button also disables the current paths for the interlock circuit to stop a cycle in progress and prevents the lamp from enabling automatically.

NOTE: The following discussion uses screen shots for reference. VelaCure firmware is frequently updated, so the screen shots shown may not apply in every respect to your system. They should be used for general instruction in understanding the HMI and operating the system.

Status Indicators

Icons displayed immediately beneath the title bar of the READY or WAITING screens give the status of the system.

- (upper left) means an interlock is open. This will force the system into the WAITING screen.
- (upper left) means the lamp is not lit.
- (upper left) means the lamp is lit.
- (upper left) means the shutter is overheated.
- Lamp type (centered) is either F300, LH6 or CW306.
  - Power level will be displayed if LH6 is selected.
- "SE" (upper right) means the shutter is enabled. This cannot be changed.

NOTE: User Passcode is 147.

NOTE: Calibration feature is not applicable to systems using VelaRad radiometer.

Setup Screens

Pressing MENU will bring up the MAIN MENU screen shown below.

Figure 5. Main Menu Screen

- RUN SETUP (password protected) – to change the run mode and target values.
  - Press the desired radio button to change the mode (TIME or DOSE).
  - Touch the displayed value to change it without changing the mode.

- Target value units must be in seconds or J/cm$^{2.}$

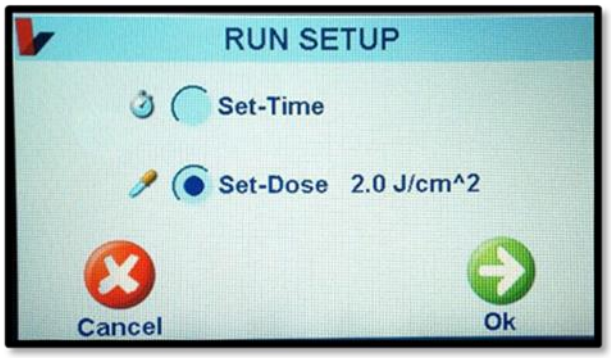


Figure 6. Run Setup Screen

- SYSTEM SETTINGS (password protected) – for user preferences, including lamp type.
  - You must select the lamp type.
  - Select "Auto-Run" so an exposure will start as soon as all conditions are met.
  - Select "Enable Cal. PW" (calibration password) if desired.
  - Select "Disable-buttons" to disable Run and Disable Lamp buttons. The system can only be run from the PLC in this case.
  - DETAIL button is for diagnosis/troubleshooting only.

Figure 7. System Settings Screen #1

- Press MORE to get to 2nd System screen.
  - If set Cal. Time is selected, the calibration run will always be the displayed amount; press the value to change the duration. If it is not selected, the calibration run duration will be the same as the most recent regular exposure. This is only applicable to system not using VelaRad radiometer.
  - Select Passcode to require the user password to be entered to change settings and run setup.
  - Serial #: is the serial number of the VelaCure.
  - Lamp Delay: is for variable power lamps to turn the lamps to full power before shutters open.
  - POWER will appear if an LH6 lamp is selected. Use this to adjust lamp power.

Figure 8. System Settings Screen #2

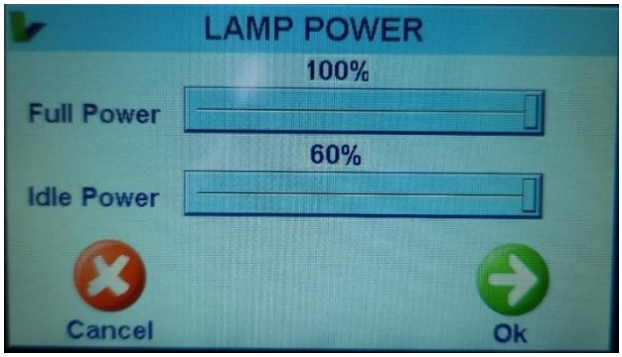


Figure 9. Lamp Power Screen

- REMOTE (password protected) – to set the range for remote dose setting.
  - Correlates minimum and maximum dose or time target to remote dose 6-bit input. For example, min/max settings of 0.0 and 6.3 means the following:
    - Remote dose input of 000000 will be 0.0 J/cm2 (or sec).
    - Remote dose input of 111111 will be 6.3 J/cm2 (or sec).
    - Each bit will be 0.1 J/cm2 (or sec).
  - Set Min and Max Target values as needed to ensure remote dose range required.

Figure 10. Remote Setup Screen

- CALIBRATE (password protection optional) – to correlate the internal irradiance monitor to a calibrated radiometer. See Section 14 below for details.
  - Have your radiometer ready and follow the on-screen instructions.

NOTE: Multi-Treat is automatically disabled for calibrations.

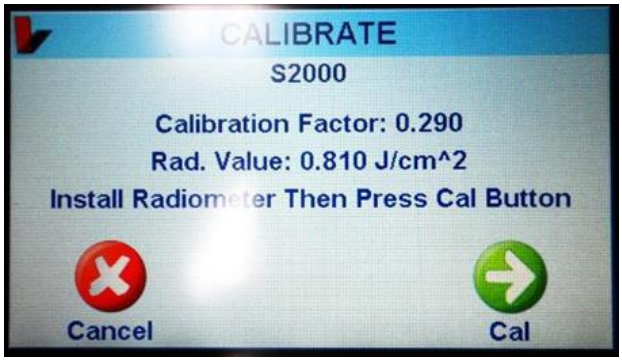


Figure 11. Calibrate Screen

NOTE: Calibrate is a legacy feature, no longer supported. It is not accessible if a VelaRad radiometer is installed.

- ABOUT – to show unit model number, serial number, firmware revision, service contact information.

Figure 12. About Screen

Machine States

There are six basic machine states, each indicated by a blue banner across the top of the screen with the state name displayed. The lamp is completely controlled by the VelaCure system. For safety, the lamp will turn off any time a fault occurs. If Auto Lamp is enabled, it will automatically turn on once the fault is cleared and acknowledged. If the machine has the optional front panel user interface; the START/OK and STOP/CANCEL buttons will indicate the machine state or indicate when the button can be pressed.

- LAMP DISABLED
  The lamp is disabled. Pressing Enable (or sending Lamp Enable from PLC) will start the lamp power-on cycle, displaying the lamp power-on status. The system will transition to WAITING state while the lamp is powering up. The optional STOP/CANCEL button will be illuminated in the lamp disabled state.

Figure 13. Lamp Power-Up Screen

NOTE: Pressing Cancel will stop the lamp on sequence and send the system to Waiting with the lamp disabled.

- WAITING
  The system is waiting for essential conditions to be met before advancing, such as lamp power up, interlocks or part entry door status. This is not a fault state. When those conditions are satisfied, the controller will advance to the READY state. You may access user-settable parameters by pressing MENU or the target value in the center of the screen. Turn the lamp off by pressing Disable Lamp. The optional STOP/CANCEL button will be illuminated in the waiting state.

Figure 14. Waiting Screen

NOTE: The Run button is not active (gray), so it is not possible to perform an exposure. Shutters are enabled (SE), lamp is enabled and lit ( ) and dose mode is selected with a 5.0 J/cm^2 target. It is in Waiting state because the VelaRad connection is missing.

- READY
  The system is ready to begin a run. All interlocks are satisfied and there are no faults. The lamp need not be on to be in READY state. Pressing RUN will advance to the RUNNING state. The optional START/OK button will be illuminated in the ready state. Pressing the optional STOP/CANCEL button in ready will transition into waiting state.

Figure 15. Ready Screen

NOTE: The RUN button is no longer gray, meaning it is active.

- RUNNING
  A run is underway. Press CANCEL at any time to stop the run. The optional STOP/CANCEL button will be illuminated in this state to indicate it can be pressed.

Figure 16. Running Screen

NOTE: Dose mode, target 6.4 J/cm2. Pressing Cancel (or sending Stop from PLC) will terminate the exposure and turn the lamp off.

- RUN COMPLETE
  A run has successfully completed. This state can be exited only by pressing OK or sending Acknowledge from PLC. The unit will then go to WAITING or READY as appropriate. The optional START/OK button will be illuminated to indicate it can be pressed.

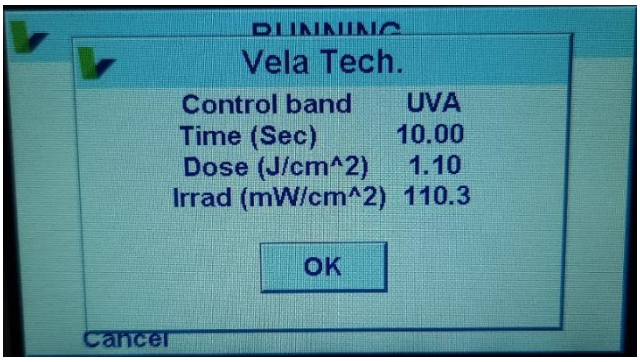


Figure 17. Run Complete Pop-Up Screen

NOTE: Pressing OK or asserting Acknowledge will clear the pop-up. With the optional START/OK button a quick button press will acknowledge the message and the unit will go to waiting or ready state as appropriate; A long button press will acknowledge the message, and the unit will go to the running state if all interlocks are satisfied and no faults exist.

- CHAMBER FAULT
  The VelaCure controller has detected a fault in the chamber, shutter, interlocks or lamp. This state can be exited only by first clearing the fault then pressing OK (or sending Acknowledge from PLC). The unit will then go to WAITING or READY state as appropriate. If the fault is not cleared when OK is pressed, the Error popup will reappear. The optional STOP/CANCEL button will be illuminated in the chamber fault state. The optional Start/OK button can be used to acknowledge the popup message and exit the fault state once the fault is cleared.

Figure 18. Fault Pop-Up Screen

NOTE: Displayed text indicates the fault. In this case the shutter has failed. Press OK or assert Acknowledge after fixing the fault. Pressing OK or asserting Acknowledge will clear the pop-up.

Controller Power Up

During system power-up, the processor checks the status of the system. If all is well, the **READY** screen will be displayed. The **RUN** and **MENU** buttons along the bottom will be active (colored).

If the door is not in the proper position, the **WAITING** screen will be displayed along with icons indicating the issue (e.g., the door icon will not be shown). The **RUN** button will be inactive (grayed out). Once all issues are addressed, the READY screen will be displayed.

Lamp Power

The unit may be configured to automatically turn the lamp on and leave it on as long as the controller is powered up ("Auto-Lamp" in the System Setup screen). With this selection, the lamp will turn on (make light) if there are no lamp faults and the shutter is closed. If a run is cancelled by the user or a fault occurs, the lamp will turn off. It will begin the lamp power up sequence once the pop-up screen is acknowledged. If the fault is not cleared, the power up sequence will stop.

Enable/Disable Lamp

You can turn the lamp off by pressing the **Disable Lamp** button in the **Ready** or **Waiting** screen. The button will change to red with text "Enable Lamp." Press this to turn the lamp back on.

If the optional front button panel is installed, the E-stop is required to be reset to enable the lamp.

Lamp Selection

The VelaCure system can control Heraeus/Fusion UV F300 and LH6 lamps, Nordson CW306 and CW2-410 lamps, and Excelitas S2000. As well as LED UV Excelitas Semray and AC8. You must select your lamp from the list in SYSTEM SETTINGS screen.

PERFORMING AN EXPOSURE

Exposures are simple: from the READY screen, simply press RUN, assert Start at the PLC, or press the optional START/OK button. The controller will immediately start an exposure. Once the target dose or time is reached it will end the exposure. At this point the Run Complete popup will appear. After you acknowledge the successful run, the system is ready for the next run.

No user interaction is required after pressing the RUN button, sending Start from PLC, or pressing the optional START/OK button.
Pressing CANCEL during a run, sending Stop from PLC, pressing the optional STOP/CANCEL, or optional E-Stop button will stop the run, turn off the lamp and pop up a screen identifying why the run stopped. The system will transition to Fault state. If the E-stop is not reset the lamp will not automatically reset.

If any fault occurs, the controller will stop the run, turn off the lamps and identify the fault.

CALIBRATION

Two feedback options are available for dose control: an externally mounted, calibrated radiometer ("VelaRad"); or an internal, uncalibrated sensor ("sensor"). Only one of these feedback methods is installed on your system.

VelaRad Option

The externally mounted radiometer must be returned to Vela for recalibration every 6 months or less. No calibration between recalibration dates is needed. You should have a spare VelaRad on hand to use while the main one is being recalibrated. You may continue to use the spare radiometer until it comes due for calibration.

To calibrate the VelaRad radiometer (if applicable):

- Remove the radiometer in service.
  - Disconnect the Ethernet cable from the radiometer (RJ45 jack).
  - Loosen the two captive thumbscrews until the radiometer is free.
- Install the spare radiometer (reverse above steps)
  - Return removed radiometer to Machine Solutions.
- Contact service@machinesolutions.com for instructions.

You do not need to make any changes at the VelaCure controller after changing radiometers.

Sensor Option

This option was discontinued in Jan 2019. It is described here for legacy systems.

The internal sensor must be correlated with an externally mounted, calibrated radiometer to properly perform dose control. To that end, a radiometer holder for the Power Puck from EIT, Inc., has been installed on your system. Your unit was calibrated prior to shipment; however, re-calibration is recommended after installation and periodically as needed.

To calibrate the chamber (if applicable):

- Prepare the chamber
  - Remove all parts and fixtures from the chamber. (If desired, calibration can be done with parts in place to better simulate actual operating condition. You should use the same parts when doing a calibration for consistency.)
- Prepare system for calibration run
  - From the READY screen, press MENU  .
  - The MAIN MENU screen will display.
  - Press CALIBRATE  .
  - Enter passcode, if needed.

- CALIBRATE screen will display, showing the most recently used radiometer value (in J/cm^2) and the present calibration factor.

- Install the radiometer
  - Place the Power Puck in the puck holder, making sure the alignment stud penetrates the small hole in the chamber wall.
  - Turn the Power Puck on, then press the reset button again to start taking data.
  - Close the puck holder door.

- Calibrate
  - Press CAL. The shutter will open, exposing the radiometer for the duration determined by Set Cal. Time in System Settings.
  - The shutter will close.
  - Open the puck holder door, press reset on the puck to stop taking data and remove it.
  - On the user interface, enter the UVA dose shown on the Power Puck. It must be in J/cm^2 ; do not enter mJ/cm^2 or any other band than UVA.
  - The screen will return to CALIBRATE.
  - Press CANCEL.

- Congratulations! The calibration is complete.

NOTE: The Power Puck irradiance and dose display can be user configured. Be sure to enter dose only in units of J/cm^2 regardless of how it is displayed. Be sure to enter the UVA dose only, in J/cm^2. Do not enter dose for any wavelength band other than UVA. Do not enter dose in mJ/cm^2 or $\mu J/cm^2$.

ERROR MESSAGES AND TROUBLESHOOTING

Certain conditions will cause a popup window and prevent further operation. The following faults/errors may appear in the popup window:

Interlock Fault

The entry door, radiometer door or external interlock has opened.

Lamp Power-Up Failure

The lamp failed to turn on in the allotted time.

Lamp Fault

The lamp has faulted. The specific fault is displayed on the lamp power supply front panel.

Lamp Feedback Lost

This will occur if the communication with the lamp is lost, or the lamp feedback is lost during a run.

Unexpected UV in Chamber

There is UV in the chamber that was not expected.

Shutter Timeout

The shutter failed to open or close within 3 seconds after pressing RUN.

Shutter Failure

The shutter has changed state without permission.

Door Transition Timeout

The door failed to open or close within 3 seconds after pressing RUN.

Invalid Radiometer Value

This will occur during calibration if the entered radiometer value contains non-numerical characters or if the combination of radiometer value and internal UV sensor reading is out of range. This can only occur during calibration.

Lamp Power Below Minimum.

This will occur if the internal UV sensor output is too low.

ADC Saturated

This will occur if the internal UV sensor output is too high.

In each case, clear the faulty condition and press OK in the popup window to proceed. A second fault might appear if multiple faults occurred initially, and all were not cleared.

This is not a complete list of faults. If you experience a fault that is not described and the cause is not clear, contact Service@machinesolutions.com.

CARE AND MAINTENANCE

Please follow these guidelines during use to maintain the high quality and superior performance of your VelaCure system:

- Take care not to touch the chamber walls with bare fingers. Handle these surfaces only when wearing clean, powder-free gloves.
- Do not use sharp objects such as pens or pencils to press buttons on the touch screen
- Refer to the lamp manual for care and maintenance of the lamp

Spills Inside The Chamber

Spills of curing material that are allowed to cure to the chamber surfaces will permanently degrade chamber performance. Many times, cured spills can be peeled off the chamber surface with little lasting damage. However, spills should be cleaned as they occur.

Your system may have been supplied with a drip pan to catch spills directly under the catheters. Most spills or drips will be limited to this area. The drip pan is disposable. Contact Vela for replacements.

Consult your UV material supplier for recommended precautions regarding the proper handling, use and disposal of these products.

Drip Pan Replacement

Remove chamber access port (if so equipped). The drip pan is resting on the floor immediately inside. Lift out the old one, taking care not to spill any material that may be on it. Place the new drip pan in place, aligning the chamber floor alignment pins with the alignment holes in the drip pan. Replace the access cover.

Chamber Cleaning (Interior)

The chamber requires minimal maintenance. Occasional cleaning of the chamber walls is recommended if dust or dirt can accumulate. If your coating evaporates readily or outgasses during cure, you may need to clean the chamber walls often.

To clean any of the white reflective surfaces:

- Use a lint free wipe that is pre-saturated with isopropyl alcohol or isopropyl alcohol and water mix.
- Gently wipe the reflecting surfaces with the wetted wipe. Do not compress the material; be especially careful that your fingernails do not press into the material.
- Let dry. If the wipe is properly lightly wetted, the surfaces will dry within seconds.
- If isopropyl alcohol is not effective, acetone may be used following the same procedures. Do not saturate the chamber walls.
- Never apply any fluids (including water, IPA and acetone) directly to the reflective surfaces.

Chamber Exterior Cleaning

The chamber exterior surfaces are anodized aluminum, stainless steel, Delrin and Teflon. All surfaces may be cleaned with water or isopropyl alcohol. Do not use acetone on exterior surfaces for cleaning. Do not apply cleaning fluid directly to the surfaces being cleaned. Do not use abrasive cleaners.

Touch-Screen Display

Clean the touch-screen with a wipe lightly wetted with distilled water or isopropyl alcohol. Do not apply cleaning fluid directly to the display. Do not allow ingress of any liquid; the HMI enclosure is not liquid-tight. Do not use abrasive cleaners.

Lamp Cleaning

Refer to the lamp manual for directions on cleaning and maintaining the lamp system.

CAUTION: Follow these cleaning instructions. Failure to do so may result in damage to the chamber, surfaces and performance.

CAUTION: Avoid getting finger oils on the chamber walls. When handling the chamber or drip pan, wear clean, powder-free gloves.

CAUTION: Do not press into the chamber walls; they are compressible. Accumulated compressions will degrade performance.

CAUTION: Do not allow the ingress of any liquid into the VelaCure chamber. Do not clean by spraying it down. Do not immerse.

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