



# SYNRAD Technical Bulletin

# 0019

Technical Issue: Replacing v20/v40 Lasers with an OEM v30 Laser

Date: 18 May 2010

## Description:

This Bulletin describes the steps necessary to replace an existing v20 or v40 laser with an OEM v30 laser. There are many important differences, so review this document carefully before proceeding.

Although the OEM v30 laser has both DB-9, *Interface A*, and RJ45 *Interface B*, I/O connections, this document covers only the conversion from the v20/v40 DB-15 *User I/O* connector to the OEM v30 DB-9 *Interface A* connector. The RJ45, *Interface B* connector is intended for customers using the v30 to replace existing laser systems previously configured for an RJ45 interface.

**Note:** Firestar v20 lasers are no longer being manufactured.

This Bulletin covers the following topics:

- Mechanical
  - Mounting
  - Beam Exit Height
  - Cooling
  - Keypress—OEM models
- Electrical
  - I/O Voltage Levels
  - Interface A Connector (DB-9)
  - Firestar v20/v40 to OEM v30 I/O Conversion
- Status LEDs (Error Codes)

## Mechanical

### Mounting

The baseplate on Firestar v20/v40 lasers has three tabs extending from the baseplate. Each tab includes a hardened ball bearing protruding below the baseplate to eliminate possible distortion of the tube caused by variations in mounting surface flatness. Each tab also contains a 1/4-20 UNC threaded hole and a 0.25" (6.35 mm) diameter thru hole, for using metric fasteners. Because these tabs extend beyond the laser baseplate, mounting fasteners can be inserted from the top, through the baseplate, into the mounting surface; or from below, through the mounting surface and then through the baseplate.

The OEM v30 laser baseplate does not have mounting tabs; the three mounting locations on the baseplate have the same hardened ball bearings and 1/4-20 UNC threaded mounting holes, but also include M6x1 ISO (metric) threaded holes. The layout of v30 mounting holes does not correspond to either the v20 or v40 mounting layout. Refer to the *Firestar v30 Reference Guide* or the SYNRAD web site ([www.synrad.com](http://www.synrad.com)) for detailed OEM v30 outline & mounting drawings.



## Beam Exit Height

The beam exit height of the OEM v30 laser, 2.905"  $\pm$ 0.010" (73.79mm  $\pm$ 0.25 mm), is identical to that of v20/v40 lasers.

## Cooling

Firestar v20/v40 lasers are available in air-cooled (SA) models, where the customer is required to install cooling fans; fan-cooled (KF/SF) models that include built-in cooling fans; and water-cooled (KW/SW) models.

OEM v30 lasers are available in air-cooled (SA) and fan-cooled (SF) models only. The customer must provide cooling fans (and a fan power source) when a v30SA model laser is installed.

## Keyswitch–OEM models

Firestar v20 and v40 lasers are available in either Keyswitch (mechanical keyswitch and shutter) or OEM (no keyswitch, no shutter) configurations while Firestar v30 lasers are available only as OEM models. When replacing a v20/v40 Keyswitch-equipped laser with an OEM v30, users should be aware that, on OEM v30 lasers, lasing is enabled five seconds after the v30 *Laser Enable* input is activated. The OEM or System Integrator performing the replacement must ensure that appropriate safeguards are in place to prevent unintended lasing.

## Electrical

### I/O Voltage Levels

OEM v30 inputs and outputs operate using a 5 VDC logic level referenced to DB-9 Pin 8, *GND* (Ground). Although the PWM input (Pin 1, *PWM Positive*, and Pin 6, *PWM Negative*) is optoisolated, **all other inputs and outputs are non-isolated**; therefore, the user must ensure that I/O signals are clean and conditioned. OEM v30 outputs are designed as voltage sources. They can provide only 5 VDC at 20 mA typical, 40 mA maximum to a ground-referenced load.

Note that this voltage level differs considerably from the bi-directional  $\pm$ 5–24 VDC voltage range used by v20/v40 lasers. If your existing equipment interface uses voltages other than +5.0 VDC you must adapt your circuit or components to a voltage level of +5 VDC with no more than 40 mA of load current.

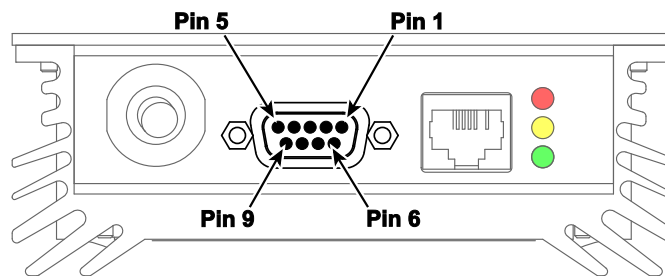
## Interface A Connector (DB-9)

Table 1 lists pin assignments for the v30's DB-95 *Interface A* connection.

**Table 1 Interface A pin assignments**

DB-9 Pin #	Signal Name	Signal Description
1	<i>PWM Positive</i> (input)	Connection for positive side of PWM signal
2	<i>Laser Ready</i> (output)	Output logic high (+5 V) when ready to lase
3	<i>Lase Indicator</i> (output)	Output logic high (+5 V) when lasing
4	<i>Over Temperature Fault</i> (output)	Output logic high (+5 V) if overtemp condition detected
5	<i>DC Out</i>	+5 VDC, 250 mA user voltage source
6	<i>PWM Negative</i> (input)	Connection for negative side of PWM signal
7	<i>DC Voltage Fault</i> (output)	Output logic high (+5 V) if input DC under/over voltage condition detected
8	<i>Ground</i>	Ground point for all I/O signals <b>except</b> <i>PWM Positive</i>
9	<i>Laser Enable</i> (input)	Laser enabled when input logic high (+5 V)

Figure 1 illustrates the physical layout of OEM v30's *Interface A* (DB-9) connection.



**Figure 1 Physical layout of OEM v30 DB-9 connection**

### PWM Input

Connect your PWM Command signal (+5 VDC, 5 kHz nominal) to Pin 1, *PWM Positive*, and Pin 6, *PWM Negative*. The OEM v30 does **not** generate an internal tickle signal, so users **must** provide a 5 kHz, 1  $\mu$ s tickle pulse anytime there was no PWM signal applied during the previous 200- $\mu$ s period.

**Note:** You must apply +5 VDC to Pin 9, *Laser Enable*, before applying a PWM Command signal.



For detailed descriptions of tickle and PWM Command signals, refer to the Technical Reference chapter in the *Firestar v40 Operator's Manual*.

Table 2 lists PWM input pins on the *Interface A* (DB-9) connector and Table 3 provides tickle/PWM signal specifications.

**Table 2 PWM input pin assignments**

DB-9 Pin #	Signal Name	Signal Description
1	<i>PWM Positive</i>	Optoisolated input for PWM Command and tickle signals
6	<i>PWM Negative</i>	Negative (return) side of optoisolated PWM/tickle signal

**Table 3 Tickle/PWM signal specifications**

Input Signal	Tickle Signal	PWM Command Signal
Voltage	+3.5 to +6.7 VDC (5V nominal)	+3.5 to +6.7 VDC (5V nominal)
Current	10 mA @ +6.7 VDC	10 mA @ +6.7 VDC
Pulse Duration	1 $\mu$ s	n/a
Frequency	5 kHz	DC–25 kHz

### Auxiliary DC Power

A +5 VDC, 250 mA user output voltage is available on Pin 5, *DC Out*. This output voltage can be used to provide the +5 V *Laser Enable* signal on Pin 9. Table 4 lists +5 VDC output pins on the *Interface A* (DB-9) connector.

**Table 4 +5 VDC pin assignments**

DB-9 Pin #	Signal Name	Signal Description
5	<i>DC Out</i>	+5 VDC, 250 mA max. user output voltage
8	<i>GND</i>	Ground point for +5 VDC output



### Signal Inputs

The OEM v30 input voltage requirement of +5 V differs considerably from the bi-directional  $\pm 5$ –24 VDC voltage range used by v20/v40 lasers. If your existing equipment interface uses voltages other than +5.0 VDC, you must adapt your circuit or components to a voltage level of +5 VDC with no more than 40 mA of load current.

**Important Note:** When switching +5 VDC to the *Laser Enable* input (Pin 9) through a switch or relay contact, we highly recommend adding a 100 Ohm, 1/4 watt current-limiting resistor in series between the switching device and the *Laser Enable* input.

The OEM v30's *Interface A* connector provides one input, *Laser Enable*, in addition to the PWM Command input. Applying +5 VDC between Pin 9, *Laser Enable*, and Pin 8, *GND*, causes the laser's *RDY* indicator to illuminate yellow, indicating that lasing is enabled, after a five-second delay.

**Note:** You must apply +5 VDC to Pin 9, *Laser Enable*, before applying a PWM Command signal. Configure your control system to provide a *Laser Enable* signal only after all other safe operating conditions are met

Table 5 lists signal input pins on the *Interface A* (DB-9) connector.

**Table 5 Signal input pin assignments**

DB-9 Pin #	Signal Name	Signal Description
9	<i>Laser Enable</i>	Logic input enables lasing when high (+5 V); disables lasing when low (0 V)
8	<i>GND</i>	Ground point for <i>Laser Enable</i> input

### Input signal wiring notes

In electrically noisy environments, we recommend using shielded, multi-conductor I/O cable as well as a shielded backshell when connecting field wiring to the v30's DB-9 *Interface A* connector.

To minimize ground loop noise, ground the cable shield at the signal source only. The cable shield at the DB-9 *Interface A* connector must be left floating unless you are using the OEM v30's +5 VDC *DC Out* output as the I/O signal source.



### Signal Outputs

The OEM v30 output voltage level (+5 VDC) differs considerably from the bi-directional  $\pm 5$ –24 VDC voltage range used by v20/v40 lasers. If your existing equipment interface uses voltages other than +5.0 VDC, you must adapt your circuit or components to a voltage level of +5 VDC with no more than 40 mA of load current.

The OEM v30's *Interface A* connector provides four +5 V logic level outputs that communicate laser status to the control system. The *Laser Ready* output on Pin 2 is high (+5 V) when the laser is ready to lase and is low (0 V) when the laser is not ready. Pin 3, *Lase Indicator*, is high (+5 V) when the PWM Command signal is sufficient to induce laser output and is low (0 V) when no beam is being emitted (during tickle). Pin 4, *Overtemp Fault*, is high (+5 V) when laser temperature is above its upper thermal limit and low (0 V) when sensed temperature is within specifications. Pin 7, *DC Voltage Fault*, is high (+5 V) when an under/over voltage condition is sensed and is low (0 V) when the DC input voltage is within specifications.

Table 6 lists signal output pins on the *Interface A* (DB-9) connector.

**Table 6 Signal output pin assignments**

DB-9 Pin #	Signal Name	Signal Description
2	<i>Laser Ready</i>	Logic output goes high (+5 V) when laser ready to lase; output low (0 V) if laser not ready
3	<i>Lase Indicator</i>	Logic output goes high (+5 V) when lasing; output low (0 V) if not lasing
4	<i>Overtemp Fault</i>	Logic output goes high (+5 V) if laser temp too high; output low (0 V) if temp OK
7	<i>DC Voltage Fault</i>	Logic output goes high (+5 V) if laser DC voltage too high/too low; output low (0 V) if DC voltage OK
8	<i>GND</i>	Ground point for output signals



## Firestar v20/v40 to OEM v30 I/O Conversion

In order to retrofit an OEM v30 laser into an existing v20 or v40 application, you must make changes to your system's physical field wiring and circuitry. Refer to the conversion sections below for specific details. Table 7 lists a pin-to-pin summary and footnotes for converting signals on the Firestar DB-15 *User I/O* connector to the v30's DB-95 *Interface A* connector.

**Important Note:** The OEM v30's I/O voltage requirements of +5 V differs considerably from the bi-directional  $\pm 5-24$  VDC voltage range used by v20/v40 lasers. If your existing equipment interface uses voltages other than +5.0 VDC, you must adapt your circuit or components to a voltage level of +5 VDC with no more than 40 mA of load current.



**Table 7 v20/v40 to OEM v30 I/O conversion summary**

Firestar DB-15 User I/O Connector		v30 DB-9 Interface A Connector	
Pin #	Signal Description	Pin #	Signal Description
1	<i>PWM Return</i>	6	<i>PWM Negative</i>
2	<i>Remote Reset/Start Request</i> input (1)		n/a
3	<i>Remote Interlock</i> input (1)	9	<i>Laser Enable</i> input (2)
4	<i>+5 VDC Aux Power</i> (3)	5	<i>DC Out</i> (4)
5	<i>+24 VDC Aux Power</i> (5)		n/a
6	<i>Laser Active</i> output (6)	3	<i>Lase Indicator</i> output (7)
7	<i>Over Temperature</i> output (8)	4	<i>Over Temperature Fault</i> output (9)
8	<i>Laser Ready</i> output (6)	2	<i>Laser Ready</i> output (7)
9	<i>PWM Input</i> (10)	1	<i>PWM Positive</i> (11)
10	<i>Shutter Open Request</i> input (1)		n/a
11	<i>Input Common</i>	8	<i>GND</i>
12	<i>Aux DC Power Ground</i>	8	<i>GND</i>
13	<i>Output Common</i>	8	<i>GND</i>
14	<i>Shutter Open</i> output (6)		n/a
15	<i>Interlock Open</i> output (8)		n/a
	n/a	7	<i>DC Voltage Fault</i> output (9)

**Table 7 footnotes**

- (1) Optoisolated input;  $\pm 5$ –24 VDC, 40 mA.
- (2) +5 VDC logic level input. If switching *Laser Enable* input (for example, as a door interlock input) through a switch or relay contact, you must add a 100-Ohm, 1/4-watt current-limiting resistor in series between the switching device and the *Laser Enable* input. *Laser Enable* input must be active before a PWM signal is applied to Pin 1, *PWM Positive*.
- (3) +5VDC, 500 mA max.
- (4) +5 VDC, 250 mA max.
- (5) +24 VDC, 500 mA max.
- (6) Optoisolated switch; normally closed, open if not active or fault;  $\pm 5$ –24 VDC, 50 mA.
- (7) Logic level output; voltage source – 20 mA typ., 40 mA max at 5 VDC; normally +5 V, 0 V if not active or fault.
- (8) Optoisolated switch; normally open, closed if not active or fault;  $\pm 5$ –24 VDC, 50 mA.
- (9) Logic level output; voltage source – 20 mA typ., 40 mA max at 5 VDC; normally 0 V, +5 V if not active or fault.
- (10) PWM input, reference to *PWM Return* (Pin 1); +5 VDC, 10 mA max.
- (11) PWM input, reference to *PWM Negative* (Pin 6); +5 VDC, 10 mA max.

### PWM input circuit conversion

Table 8 shows pin-to-pin connections for converting your system’s tickle and PWM Command signals to the v30’s DB-9 *Interface A* connector. Except for wiring your existing tickle/PWM Command signals to the correct pins, tickle and PWM signal levels are fully-compatible. If your existing system does not provide a 1  $\mu$ s, 5 kHz tickle signal, then you must configure your signal source to generate a tickle signal. Firestar v30 users **must** provide a 5 kHz, 1  $\mu$ s tickle pulse anytime there was no PWM signal applied during the previous 200- $\mu$ s period.

**Table 8 PWM input conversion**

Firestar DB-15 User I/O Connector		v30 DB-9 Interface A Connector	
Pin #	Function	Pin #	Function
9	<i>PWM Input</i>	1	<i>PWM Positive</i>
1	<i>PWM Return</i>	6	<i>PWM Negative</i>

### Input signal circuit conversion

Table 9 shows pin-to-pin connections when converting your system’s existing Firestar v20/v40 inputs to those available on the v30’s DB-9 *Interface A* connector. There are no input signals that directly correlate between v20/v40 and v30 lasers; although, it is possible to use the v30’s *Laser Enable* input to replace the v20/v40 *Remote Interlock* input **if** the existing remote interlock signal is a current-sinking +5 VDC ground referenced input. If your existing equipment interface uses voltages other than +5.0 VDC, you must adapt your circuit or components to a voltage level of +5 VDC with no more than 40 mA of load current.

**Table 9 Input signal conversion**

Firestar DB-15 User I/O Connector		v30 DB-9 Interface A Connector	
Pin #	Function	Pin #	Function
2	<i>Remote Reset/Start Request</i> (1)		n/a
3	<i>Remote Interlock</i> (1)	9	<i>Laser Enable</i> (2)
10	<i>Shutter Open Request</i> (1)		n/a
11	<i>Input Common</i>	8	<i>GND</i>

- (1) Optoisolated input;  $\pm$ 5–24 VDC, 40 mA.
- (2) +5 VDC logic level input. If switching *Laser Enable* input (for example, as a door interlock input) through a switch or relay contact, you must add a 100-Ohm, 1/4-watt current-limiting resistor in series between the switching device and the *Laser Enable* input. *Laser Enable* input **must be active before** a PWM signal is applied to Pin 1, *PWM Positive*.



### Output signal circuit conversion

Table 10 shows pin to pin connections for converting your system's existing Firestar v20/v40 output signals to those available on the v30's DB-9 *Interface A* connector. Three of the five v20/v40 output signals correlate to v30 outputs, **if** the existing v20/v40 signals are connected as current-sourcing (40 mA max!) +5 VDC ground referenced outputs. If your existing equipment interface uses voltages other than +5.0 VDC, you must adapt your circuit or components to a voltage level of +5 VDC with no more than 40 mA of load current.

**Note:** OEM v30 outputs are voltage sources. They can provide only 5 VDC at 20 mA typical, 40 mA maximum, to a ground-referenced load. **The v30 control board will be damaged if this current level is exceeded or if an external voltage is applied.**

**Table 10 Output signal conversion**

Firestar DB-15 User I/O Connector		v30 DB-9 Interface A Connector	
Pin #	Function	Pin #	Function
6	Laser Active (1)	3	Lase Indicator (2)
7	Over Temperature (3)	4	Over Temperature Fault (4)
8	Laser Ready (1)	2	Laser Ready (2)
13	Output Common	8	GND
14	Shutter Open (1)		n/a
15	Interlock Open (3)		n/a
	n/a	7	DC Voltage Fault (4)

- (1) Optoisolated switch; normally closed, open if not active or fault;  $\pm 5-24$  VDC, 50 mA.
- (2) Logic level output; voltage source – 20 mA typ., 40 mA max at 5 VDC; normally +5 V, 0 V if not active or fault.
- (3) Optoisolated switch; normally open, closed if not active or fault;  $\pm 5-24$  VDC, 50 mA.
- (4) Logic level output; voltage source – 20 mA typ., 40 mA max at 5 VDC; normally 0 V, +5 V if not active or fault.



### DC power output circuit conversion

Table 11 shows pin to pin connections for converting your system's existing Firestar v20/v40 DC power outputs to those available on the v30's DB-9 *Interface A* connector. The only auxiliary voltage available on the v30 is +5 VDC that is capable of sourcing only 250 mA.

**Table 11 DC power output conversion**

Firestar DB-15 User I/O Connector		v30 DB-9 Interface A Connector	
Pin #	Function	Pin #	Function
4	+5 VDC Aux Power (1)	5	DC Out (2)
5	+24 VDC Aux Power (3)		n/a
12	Aux DC Power Ground	8	GND

- (1) +5VDC, 500 mA max.
- (2) +5 VDC, 250 mA max.
- (3) +24 VDC, 500 mA max.

### Status LEDs (Error Codes)

The OEM v30's Status LEDs and output signals can annunciate several faults. Under normal lasing conditions, the state of v30 LED and outputs are shown in Table 12.

**Table 12 Normal LED/output state**

LED Indicator	LED Status
LASE (Red)	On
RDY (Yellow)	On
PWR (Green)	On
DB-9 Output	Signal Status
Laser Ready	High (+5 V)
Lase Indicator	High (+5 V)
Over Temperature Fault	Low (0 V)
DC Voltage Fault	Low (0 V)



Table 13 shows LED and output signal states if an over temperature condition occurs.

**Table 13 LED/output state – over temperature condition**

<b>LED Indicator</b>	<b>LED Status</b>
<i>LASE (Red)</i>	Off
<i>RDY (Yellow)</i>	Flashing
<i>PWR (Green)</i>	On
<b>DB-9 Output</b>	<b>Signal Status</b>
<i>Laser Ready</i>	Low (0 V)
<i>Lase Indicator</i>	Low (0 V)
<i>Over Temperature Fault</i>	High (+5 V)
<i>DC Voltage Fault</i>	Low (0 V)

Table 14 shows LED and output signal states if an under-voltage or over-voltage condition occurs.

**Table 14 LED/output state – under-voltage/over-voltage condition**

<b>LED Indicator</b>	<b>LED Status</b>
<i>LASE (Red)</i>	Off
<i>RDY (Yellow)</i>	Off
<i>PWR (Green)</i>	Flashing
<b>DB-9 Output</b>	<b>Signal Status</b>
<i>Laser Ready</i>	Low (0 V)
<i>Lase Indicator</i>	Low (0 V)
<i>Over Temperature Fault</i>	Low (0 V)
<i>DC Voltage Fault</i>	High (+5 V)



Table 15 shows LED and output signal states if a control board failure occurs.

**Table 15 LED/output state – control board failure**

<b>LED Indicator</b>	<b>LED Status</b>
LASE (Red)	Off
RDY (Yellow)	Flashing
PWR (Green)	Flashing
<b>DB-9 Output</b>	<b>Signal Status</b>
Laser Ready	Low (0 V)
Lase Indicator	Low (0 V)
Over Temperature Fault	Low (0 V)
DC Voltage Fault	Low (0 V)

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.