Spellman®
High Voltage Electronics Corporation

Instruction Manual

DXB SERIES

High Voltage Power Supply

MODEL :
SERIAL# :
DATE :

SPELLMAN
HIGH VOLTAGE ELECTRONICS
CORPORATION
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IMPORTANT SAFETY PRECAUTIONS

SAFETY

THIS POWER SUPPLY GENERATES VOLTAGES THAT ARE DANGEROUS AND MAY BE FATAL.
OBSERVE EXTREME CAUTION WHEN WORKING WITH THIS EQUIPMENT.

High voltage power supplies must always be grounded.

Do not touch connections unless the equipment is off and the
Capacitance of both the load and power supply is discharged.

Allow five minutes for discharge of internal capacitance of the power supply.

Do not ground yourself or work under wet or damp conditions.

SERVICING SAFETY

Maintenance may require removing the instrument cover with the power on.

Servicing should be done by qualified personnel aware of the electrical hazards.

WARNING note in the text call attention to hazards in operation of these units
that could lead to possible injury or death.

CAUTION notes in the text indicate procedures to be followed to avoid possible
damage to equipment.

WICHTIGE SICHERHEITSHINWEISE

SICHERHEIT
DIESES HOCHSPANNUNGSNETZTEIL ERZEUGT LEBENSGEFÄHRLICHE HOCHSPANNUNG. SEIN SIE SEHR VORSICHTIG BEI DER ARBEIT MIT DIESEM GERÄT.

Das Hochspannungsnetzteil muß immer geerdet sein.

Berühren Sie die Stecker des Netzteiles nur, wenn das Gerät ausgeschaltet ist und die elektrischen Kapazitäten des Netzteiles und der angeschlossenen Last entladen sind.

Die internen Kapazitäten des Hochspannungsnetzteiles benötigen ca. 5 Minuten, um sich zu entladen.

Erden Sie sich nicht, und arbeiten Sie nicht in feuchter oder nasser Umgebung.

SERVICESICHERHEIT

Notwendige Reparaturen können es erforderlich machen, den Gehäusedeckel während des Betriebes zu entfernen.

Reparaturen dürfen nur von qualifiziertem, eingewiesenem Personal ausgeführt werden.

"WARNING" im folgenden Text weist auf gefährliche Operationen hin, die zu Verletzungen oder zum Tod führen können.

"CAUTION" im folgenden Text weist auf Prozeduren hin, die genauestens befolgt werden müssen, um eventuelle Beschädigungen des Gerätes zu vermeiden.

PRECAUTIONS IMPORTANTES POUR VOTRE SECURITE

CONSIGNES DE SÉCURITÉ

CETTE ALIMENTATION GÉNÈRE DES TENSIONS QUI SONT DANGEUREUSES ET PEUVENT ÊTRE FATALES.
SOYEZ EXTRÊMENT VIGILANTS LORSQUE VOUS UTILISEZ CET ÉQUIPEMENT.

Les alimentations haute tension doivent toujours être mises à la masse.

Ne touchez pas les connectiques sans que l'équipement soit éteint et que la capacité à la fois de la charge et de l'alimentation soient déchargées.

Prévoyez 5 minutes pour la décharge de la capacité interne de l'alimentation.

Ne vous mettez pas à la masse, ou ne travaillez pas sous conditions mouillées ou humides.

CONSIGNES DE SÉCURITÉ EN CAS DE REPARATION

La maintenance peut nécessiter l'enlèvement du couvercle lorsque l'alimentation est encore allumée.

Les réparations doivent être effectuées par une personne qualifiée et connaissant les risques électriques.

Dans le manuel, les notes marquées « **WARNING** » attire l'attention sur les risques lors de la manipulation de ces équipements, qui peuvent entrainer de possibles blessures voire la mort.

Dans le manuel, les notes marquées « **CAUTION** » indiquent les procédures qui doivent être suivies afin d'éviter d'éventuels dommages sur l'équipement.

IMPORTANTI PRECAUZIONI DI SICUREZZA

SICUREZZA

QUESTO ALIMENTATORE GENERA TENSIONI CHE SONO PERICOLOSE E
POTREBBERO ESSERE MORTALI.
PONI ESTREMA CAUTELA QUANDO OPERI CON QUESO APPARECCHIO.

Gli alimentatori ad alta tensione devono sempre essere collegati ad un impianto di terra.

Non toccare le connessioni a meno che l'apparecchio sia stato spento e la capacità interna del carico e dell'alimentatore stesso siano scariche.

Attendere cinque minuti per permettere la scarica della capacità interna dell'alimentatore ad alta tensione.

Non mettere a terra il proprio corpo oppure operare in ambienti bagnati o saturi d'umidità.

SICUREZZA NELLA MANUTENZIONE.

Manutenzione potrebbe essere richiesta, rimuovendo la copertura con apparecchio acceso.

La manutenzione deve essere svolta da personale qualificato, coscio dei rischi elettrici.

Attenzione alle **AVVERTENZE** contenute nel manuale, che richiamano all'attenzione ai rischi quando si opera con tali unità e che potrebbero causare possibili ferite o morte.

Le note di **CAUTELA** contenute nel manuale, indicano le procedure da seguire per evitare possibili danni all'apparecchio.

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Chapter 1

INTRODUCTION

1.1 Description of the DXB Series

The DXB Series of bipolar X-ray generator modules are designed for OEM applications up to 140kV (±70kV) and up to 1200 watts. Its universal input, small package size and choice of three standard digital interfaces simplifies integrating the DXB into your X-ray analysis system. DSP based emission control circuitry provides excellent regulation of emission current, along with outstanding stability performance.

The dramatically reduced size of the DXB Module, compared to traditional high voltage modules, is obtained by a state of the art off-line resonant converter. The resonant converter utilizes a unique control scheme, which allows constant frequency operation while maintaining high efficiency. The high efficiency is obtained by zero current switching (ZCS) resonant control. High operating frequency, typically 50kHz, allows for low ripple and excellent dynamic response capabilities.

The DC output voltage and current are controllable over the full range of operation. Monitoring and control signals are provided for simple, yet flexible control of the power supply. The DXB series operates from 90 - 265VAC, at 50/60 Hz single phase for the 300Watt Models and 180 –264vac, at 50/60 Hz single phase for the 600Watt and 1200 watt Models. The input power factor corrected. The DXB series operates at full power continuous. The ambient temperature must be kept below the maximum rating as specified in 1.2. The standard warranty applies to the modules. Consult factory about the warranty for custom DXB modules.

1.2 DXB Specifications

- **Input Voltage:**

    90-264VAC 47-63Hz, for 300watt models

    180-264VAC 47-63Hz, for 600watt models

    180-264VAC 47-63Hz, for 1200watt models

- **Power Factor:**

    FL: 0.99, **NL:** 0.98

- **Output voltage Regulation:**
  Load Regulation: 0.01% of full voltage for a no load to full load change.
  Line Regulation: ±0.01% of full voltage over the specified input voltage range.

- **Current Regulation**:
  Load Regulation: 0.01% from 30% voltage to full voltage.
  Line Regulation: ±0.01% of full current over the specified input voltage range.

- **Ripple**: ≤ 1%rms at >20 kHz, 0.1%rms below 20 kHz.

- **Polarity:** ± Bipolar Output, Filament referenced to negative output.

- **Stability:** ≤ 25ppm/hr after a 2 hour warm up

- **Temperature Coefficient**: ≤ 50ppm / °C.

- **Temperature:**

  Operating: 0°C to 40°C
  Storage: -40°C to +85°

- **Monitoring:**

  0-10 VDC corresponding to 0-100% of output voltage
  0-10VDC corresponding to 0-100% of output current.

  0-5VDC corresponding to 0-5arms of filament current.

LOCAL Operating Features

(1) **Output Control**: Voltage, current filament limit and preheat level are externally programmable over the entire range from zero to maximum rating via 0-10VDC input.

(2) **+10VDC Reference:** A +10VDC reference is provided for local programming via two potentiometers to be used to adjust filament limit and preheat level.

(3) **High Voltage Enable:** A hardware based, dry contact closure will enable the power supply into the high voltage on mode. .

1.3 Standard Features

The DXB series incorporates several standard features designed to optimize user operation.

Slow Start: Provides a gradual increase in high voltage output until the maximum set point is reached. The standard ramp time is 5 seconds. Various slow start times can be accommodated. Consult Spellman's Sales Department for information on slow start options.
If a fault occurs, the power supply will revert to the Shutdown mode indicated by extinguishing of X-ray ON LED and the via RS-232 as HV OFF. To reset a fault, a clear command followed by HV ON command must be sent via RS-232.

Power Factor and Universal Input: The input voltage of the DXB can operate within the range from 85VAC to 265VAC for the 300Watt Model and at 180 –264vac, for the 600Watt Model. The power factor is actively corrected across this entire range and is better than 0.99 at full load.

Internal EMI Filter and Fuse Protection: An internal EMI filter and fuse provide protection against line voltage surges and power supply faults.

Remote Operating Features

Remote Control: USB, Ethernet and RS232 are standard. A provided G.U.I allow user to control the unit via RS232 and USB interfaces. An imbedded Applet web Brower allow user to control the unit via Ethernet. Refer to DXM Digital Protocol spec for Details.

Remote Monitor: Allows remote monitoring of the Output voltage, current, filament limit, preheat level and total HV On clock counter via the USB, Ethernet or RS232.

Remote Programming: Allows remote programming of the Output voltage, current, filament limit and preheat level via the USB, Ethernet or RS232.

X-ray Enable/Interlock: In local mode, allows remote ON/OFF control of the high voltage. In remote mode, the hardware based dry contact closure must be closed in order to enable the high voltage via the USB, Ethernet or RS232.

IMPORTANT

This control signal is not a safety interlock and should not be used for protection from high voltage generation for safety purposes.

1.4 System Status and Fault Diagnostic Display

If a fault occurs, the power supply will revert to the Shutdown mode indicated by extinguishing of X-ray ON led and via RS-232 as HV OFF. To reset a fault in local mode the enable must be reset. To reset a fault in remote mode a HV ON command must be sent via the RS-232, USB or Ethernet.

- **OVER CURRENT FAULT:** Indicates the over current protection circuitry has caused the high voltage to turn off. This fault will occur if the output current exceeds 110% of full scale or 110% of current program value. This fault is indicated by illumination of over current led status on the front cover and via RS-232, USB or Ethernet as Over Current.

- **OVERVOLTAGE:** Indicates the over voltage protection circuitry has caused the high voltage to turn off. This fault will occur if the output voltage exceeds 110% of full scale or 110% of program value. This fault is indicated by over voltage led status on the front cover and via the RS-232, USB or Ethernet as Over voltage.

- **ARC FAULT**: Indicates that an arc has occurred. This fault is indicated by illumination of Arc Fault led status on front cover and via RS-232, USB or Ethernet as arc fault.

- **UNDER VOLTAGE:** Indicates a failure in the voltage regulation circuitry. This fault occurs when there is a lack of output power to maintain regulation and will result in shutdown of the HV. This fault will occur if the output voltage less than 10% below the

program value. This fault is indicated by illumination of under voltage led status on the front cover and via RS-232, USB or Ethernet as under voltage.
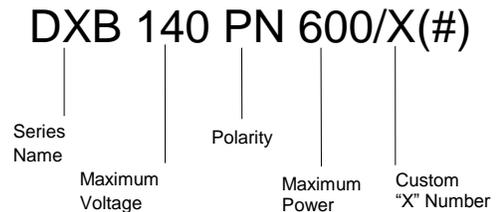
- **UNDER CURENT:** Indicates failure in the current regulation circuitry. This fault occurs when the allowable percentage of error between actual and programmed emission current is exceeded. This fault will not cause a shutdown of the HV. This fault will occur if the output current less than 10% below the program value. This fault is indicated by illumination of under current led status on front cover and via RS-232, USB or Ethernet as under current.

- **OVER TEMPERATURE:** Indicates either a failure in the cooling system that would cause the internal heat sink temperature to exceed it's operating range or the ambient temperature to exceed 40degC, resulting in shutdown of HV. This fault is indicated by over temperature led status on the front cover and via RS-232, USB or Ethernet as over temperature.

- **Filament Protection:** If the output voltage goes below 30% of full rating the filament power will be disable to protect the filament in the users X-ray tube, but the filament preheat will still be active. This will cause an undercurrent fault.

- **PS Fault Indication:** PS Faults an open collector output with a 1k ohm series impedance on J2-1, indicates that a fault has occurred. High = no faults

- **X-ray On Indication:** X-ray On Signal is an open collector output a 1k ohm series impedance on J2-14, indicates X-ray status. High = X-ray Off, Low =X-ray On

- **X-ray On LED:** when the high voltage status is "On" state it is indicated by X-RAY ON led status on the front cover

- **Power On LED:** when the input power is applied to the unit it is indicated by PWR ON led status on the front cover

1.5 Interpreting the Model Number:

The model number of the power supply describes its capabilities. After the series name is:

(1) The maximum voltage in kilovolts.
(2) The polarity of the output – PN indicates bipolar output.
(3) The maximum output in watts.
(4) Custom "X" number representing details listed in a separate specification control drawing.

DXB 140 PN 600/X(#)

Series Name

Maximum Voltage

Polarity

Maximum Power

Custom "X" Number

1.6 High Voltage Connector Pin out Diagram

CA11 RECEPTACLE

FLOATING AC FILAMENT POWER SUPPLY

L

G

FILAMENT OUTPUT

NEGATIVE POLARITY HIGH VOLTAGE POWER SUPPLY

−

+

C

S

NEGATIVE POLARITY HIGH VOLTAGE OUTPUT (FILAMENT COMMON)

CHASSIS/EARTH GROUND HIGH VOLTAGE RETURN
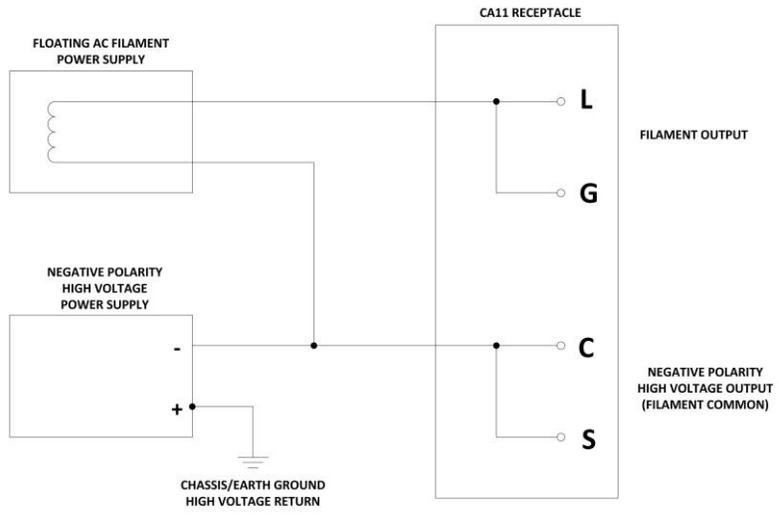
DXB – CATHODE (NEGATIVE)

TOP COVER

STATUS LIGHTS

UNDER CURRENT
X-RAY 0N

UNDER VOLTAGE
PWR ON

FIL PRE HEAT ADJ
FIL I LIM ADJ

OVER CURRENT
OVER TEMPERATURE

ARC
OVER VOLTAGE

J1 AC INPUT

FRONT PANEL

J2 CONTROL I/O

J5 ETHERNET

J4 USB

J6 HV OUT

J3 RS232
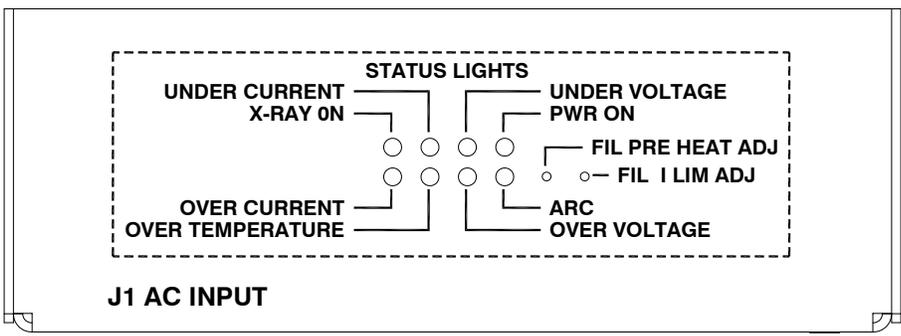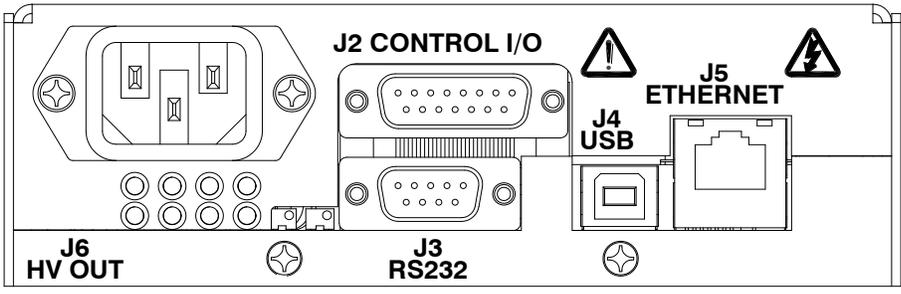
Figure 1.1 LED Legend (300W and 600W unit)

Chapter 2

INSPECTION AND INSTALLATION

Initial inspection and preliminary checkout procedures are recommended. For safe operation, please follow the step-by-step procedures described in Chapter 3, Operating Instructions.

2.1   Initial Inspection

Inspect the package exterior for evidence of damage due to handling in transit. Notify the carrier and Spellman immediately if damage is evident. Do not destroy or remove any of the packing material used in a damaged shipment. After unpacking, inspect the panel and chassis for visible damage.

Fill out and mail the Warranty Registration card accompanying the unit. Standard DXB high voltage power supplies and components are covered by warranty. Custom and special order models (with an X suffix in the model number) are also covered by warranty.

2.2   Mechanical Installation

The DXB series module power supplies are designed for installation into existing or newly developed OEM equipment. The power supply can also easily fit into bench top applications or test set requirements. Standard unit dimensions are shown in Figure 2.1

For custom mounting requirements or specific package size requirements consult Spellman's Sales Department. Spellman has many package designs available, or can design a specific enclosure for your requirements.

The DXB series utilizes solid encapsulations for corona free operation. No periodic maintenance is required.

DIMENSIONS: in.[mm]

BOTTOM VIEW

9.875 [250.36]

1.06 [27]

0.75 [19]

AIR OUT

AIR OUT

10.50 [266]

10-32 BLIND
PEMS
4 PLCS

AIR IN

FRONT VIEW

J2 CONTROL I/O

J3
ETHERNET

J4
USB

J6
HV OUT

J5
RS 232

J7
HV OUT

⚠ DANGER ⚠
HIGH
VOLTAGE

SIDE VIEW

4.75 [120]

AIR IN
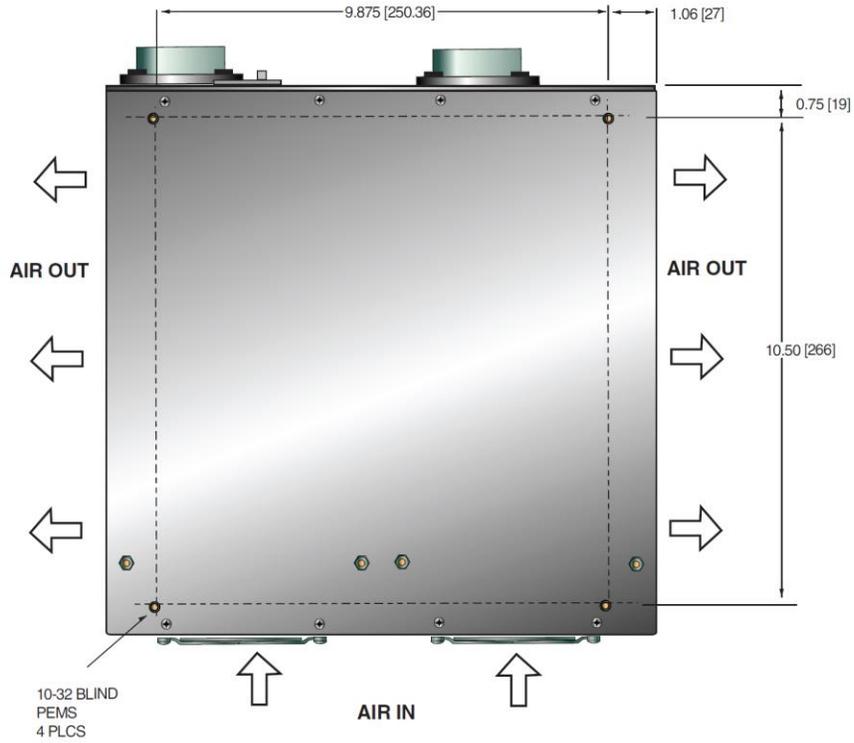
Figure 2.1 Unit Dimensions

Chapter 3

OPERATING INSTRUCTIONS
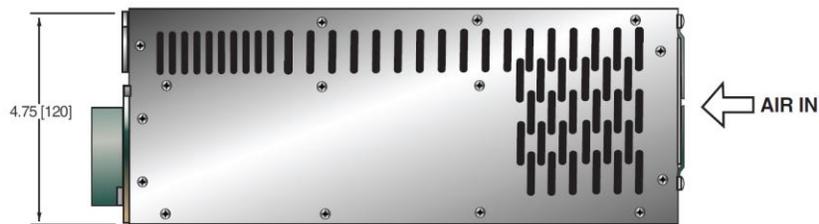
3.1 Operation

<div style="border:1px solid black;text-align:center">

WARNING

</div>

THIS EQUIPMENT GENERATES DANGEROUS VOLTAGES THAT MAY BE FATAL. PROPER GROUNDING OF ALL HIGH VOLTAGE EQUIPMENT IS ESSENTIAL.

<div style="border:1px solid black;text-align:center">

IMPORTANT:

</div>

Before connecting the power supply to the AC line, follow this step-by-step procedure.

Do not connect the power supply to the AC line until Step F is reached.

Failure to follow these procedures may void the warranty.

A)   Insure that the high voltage cable is properly installed and terminated to the load. Insure that all circuits connected to the high voltage output are safely interlocked against accidental contact. Insure external load is discharged.

B)   Check the input voltage rating on the serial nameplate of the supply and make certain that this is the rating of the available power source

C)   **PROPER GROUNDING TECHNIQUE:** The chassis of high voltage power supplies must be grounded, preferably to a water system ground using copper pipe or other earth ground. A ground stud is provided on the front panel. The return line from the load should be connected to the power supply chassis. Using a separate external ground at the load is not recommended. An IEC 320 connector is provided for connection to the line voltage source. A standard line cord is also provided.

D)   **Hook-up:**   Connect control and monitoring connections as described in this manual.

E)   For initial turn-on, program the voltage and current for zero output. Connect the enable/disable signal to disable.

F)   The input power cable may now be connected to the AC power line.

G)   Enable the power supply via the enable/disable hardware based, dry contact closure.

H)   Slowly program the output voltage and current to desired level. Monitor the output voltage and current via the monitoring test points. Note equipment operation is normal, i.e. Load is behaving as predicted.

I)   To turn high voltage off, use the enable/disable signal. If equipment is to be kept off for extended periods, disconnect power supply from line voltage source.

<div style="border:1px solid black;text-align:center">

WARNING

</div>

AFTER TURNOFF, DO NOT HANDLE THE LOAD UNTIL THE CAPACITANCE HAS BEEN DISCHARGED!
LOAD CAPACITANCE MAY BE DISCHARGED BY SHORTING TO GROUND.

<div style="border:1px solid black;text-align:center">

WARNING

</div>

THE VOLTAGE MONITOR ON THE POWER SUPPLY FRONT PANEL DOES NOT READ THE OUTPUT VOLTAGE WHEN THE POWER IS TURNED OFF, EVEN IF A CHARGE STILL EXISTS ON THE LOAD.

<div style="border:1px solid black;text-align:center">

CAUTION

</div>

ALWAYS OPERATE THE UNIT WITH THE COVER ON. DO NOT ATTEMPT TO ACCESS OR REPAIR ANY INTERNAL CIRCUITS. DANGEROUS AND LETHAL VOLTAGES ARE GENERATED INSIDE THE MODULE.

3.1.1 X-ray Tube Operation

The X-ray tube should be operated according to the X-ray manufacturers specifications. Filament Limit program and Filament Preheat program shall be set so not to exceed maximum filament current as per the X-ray tube manufacturers specifications. X-ray tube seasoning schedules and kV ramp profiles should also be per the X-ray tube manufacturers specification.

Set Filament Limit: One of the most critical settings is the Filament Limit adjustment. The Filament Limit set point limits that maximum output current of the filament power supply to protect the filament of the X-Ray tube. This setting will make it impossible for the X-Ray generator to exceed this value under any circumstance. It should be set at or below the X-Ray tube manufacturer's specification.

Filament Limit program scaling is 0 to 10Vdc = 0 to 5 amps.

When setting the Filament Limit below the maximum X-Ray tube specification, the Filament Limit should be 10-15% higher than the filament current required to achieve the maximum programmed emission current (mA) at the lowest kV setting to be used. Remember, filament maximum values are different than the REQUIRED values for emission. Setting 10-15% over the needed emission current values provides headroom as well as better trainset response characteristics.

Always keep the Filament Limit level at or below the manufacturers recommended maximum filament current specification.

Set Filament Standby (Preheat): The Filament Standby current (referred to as Filament Preheat on some product lines) is the idle current supplied to the X-Ray tube filament during X-Ray Standby (HV OFF/X-Ray disabled) conditions.

Filament Standby programing scaling is 0 to 10Vdc = 0 to 2.5 amps.

The Filament Preheat set point is typically around 1 amp to 2 amps, but the X-Ray tube manufacturer should be consulted. A good guideline to consider is the maximum Filament Preheat level should be limited to 50% of the Filament Limit specification. It is perfectly fine to set standby current to zero if fast emission current ramping is not required.

For additional information please visit this link.

3.2 Standard Features

A note on remote interface circuitry and remote signal grounding: whenever possible, electrical isolation should be provided when interfacing with any high voltage power supply. For enable/disable signal connections, an isolated relay or optocoupler should be used. For PS Fault indication an optocoupler should be used. If possible, analog programming and monitoring signals should be isolated via analog isolation amplifiers. Spellman application engineers are available to assist in interface circuitry design. All interface cables should be properly shielded. All power supply signals should be referenced to the power supplies signal ground or power supply chassis ground

Local Programming potentiometers: The filament limit and preheat level controls on the front panel can be used as follows: For local filament limit control, jump J2-4 to J2-5. For local preheat control, jump J2-6 to J2-7. See Figure 3.2.

LOCAL PROGRAMMING: Allows local adjustment of the output voltage, current filament limit and preheat level via an external voltage source. 0-10VDC signal is supplied to pin 3 of the J2 for voltage programming and 0-10 VDC signal is supplied to Pin 2 J2 for current programming. 0-10VDC signal is supplied to pin 4 of the J2 for filament limit programming. 0-10VDC signal is supplied to pin 6 of the J2 for filament preheat programming (2.5a max). Programming signals should be referenced to Pin 9 of J2, signal ground. By adjusting the voltage source from 0 volts (zero output) to 10 volts (full rated output) the desired output can be selected. See Figure 3.3 for wiring diagram and specifications.

Local Monitoring: Monitor outputs are made available for monitoring the voltage, current output and filament preheat level. The Monitor outputs are always positive regardless of the output polarity, where zero (0) to 10 (10) volts equals 0-100% of output. See Figure 3.4 for monitoring wiring and see data sheet for pin outs.

X-RAY Enable/Interlock: In Local Mode allows ON/OFF control of the high voltage. The hardware based dry contact closure must be closed in to enable the high voltage. **In Remote Mode** this I/O acts as an Interlock. The hardware based dry contact closure must be closed in order to enable the high voltage via the USB, Ethernet or RS232. This can be done by connecting pins 11 and 12 on J2. See Figure 3.5.

REMOTE PROGRAMMING:

After establishing communication with the UUT (unit under test) as per the DXM Digital Protocol spec. Switch the UUT to Remote Mode by sending a Program Local/Remote Mode command. If the unit is in Local Mode and enabled prior to switching it to Remote Mode, the UUT will shutdown and a P.S Fault indictor will occur when it is switch to Remote Mode. A clear command can be sent to clear this fault.

Remote Control: USB, Ethernet and RS232 are standard Refer to DXM Digital Protocol spec for Details.

Remote Monitor: Allows remote monitoring of the Output voltage, current, filament limit and preheat level via the USB, Ethernet or RS232.

Remote Programming: Allows remote programming of the Output voltage, current, filament limit and preheat level via the USB, Ethernet or RS232.

FILAMENT PREHEAT ADJUST
FRONT PANEL POT

J2

7

6

10 MEG

PS COMMON

FILAMENT + PREHEAT + LOCAL POT CONTROL

FILAMENT LIMIT ADJUST
FRONT PANEL POT

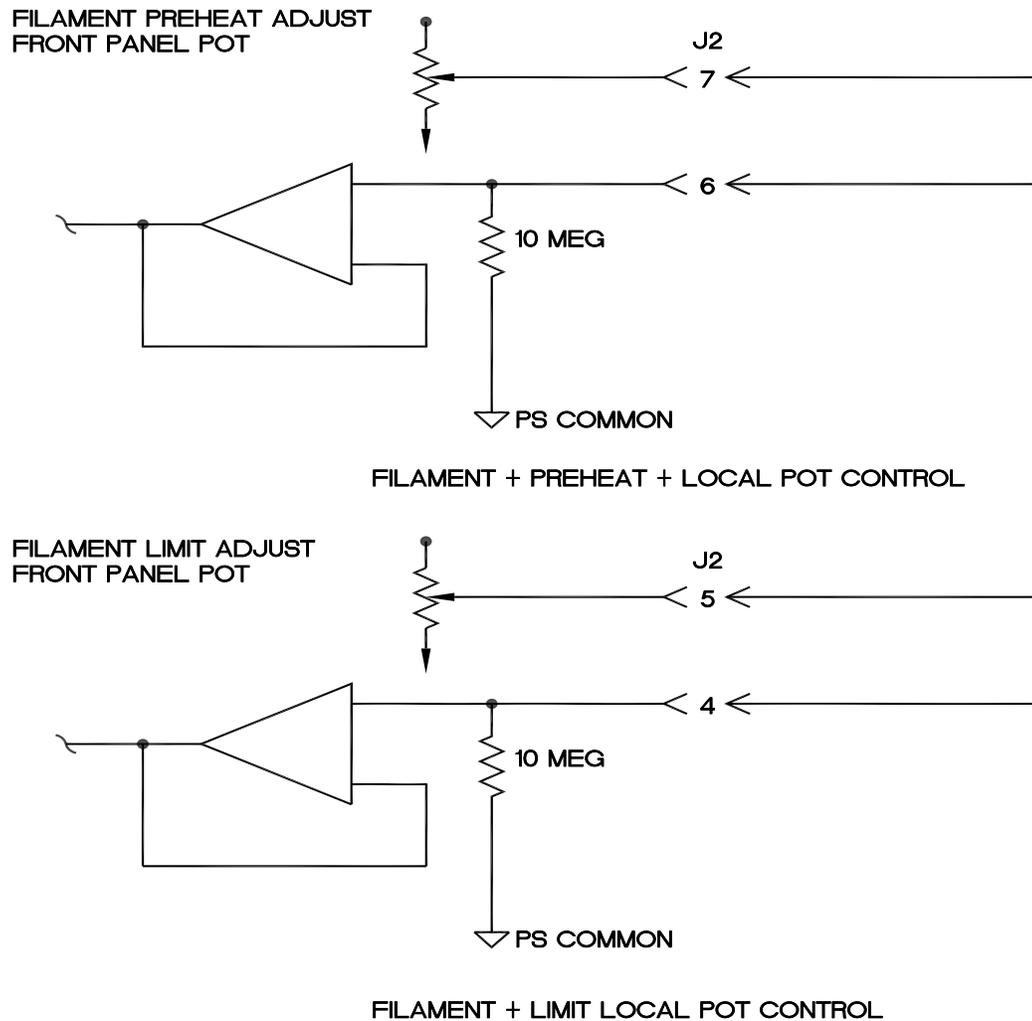J2

5

4

10 MEG

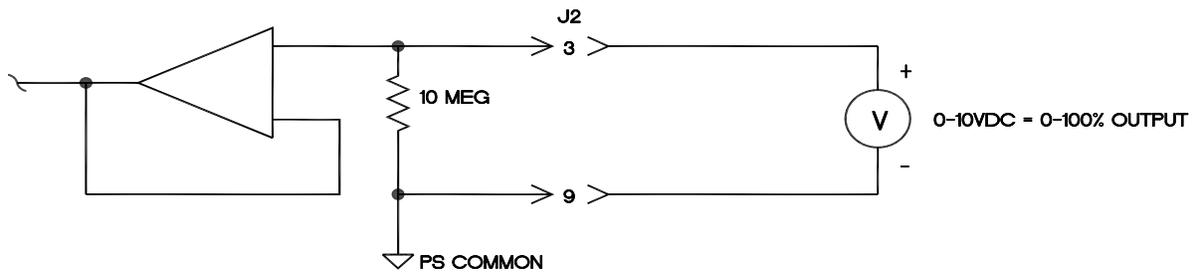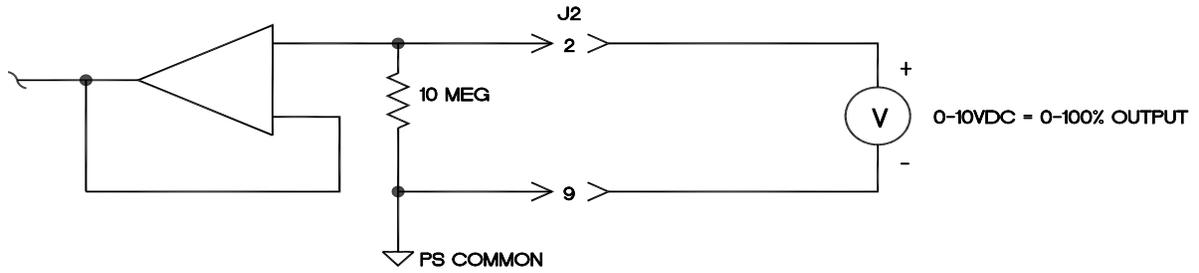PS COMMON

FILAMENT + LIMIT LOCAL POT CONTROL

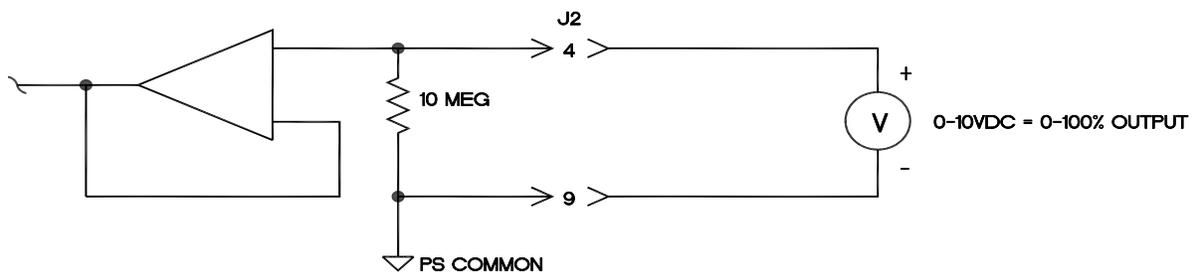**Figure 3.2 Local Programming via Internal Front Panel Pot Voltage Source.**

VOLTAGE CONTROL

0-10VDC = 0-100% OUTPUT

CURRENT CONTROL

0-10VDC = 0-100% OUTPUT
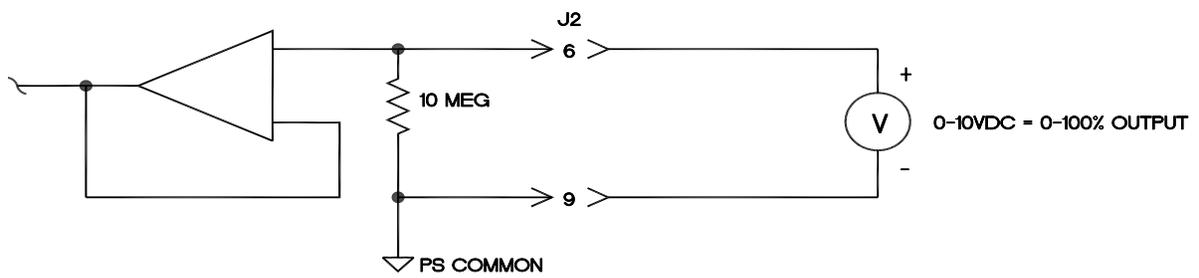
FILAMENT PREHEAT CONTROL

0-10VDC = 0-100% OUTPUT

FILIMENT LIMIT CONTROL

0-10VDC = 0-100% OUTPUT

Figure 3.3 Local Programming via External Voltage Source

5k OHM   J2

8 — + (M) -

VOLTAGE MONITOR
0-10VDC = 0-100% OUTPUT VOLTAGE

9

PS COMMON

5k OHM

10 — + (M) -

CURRENT MONITOR
0-10VDC = 0-100% OUTPUT CURRENT

9

PS COMMON

5k OHM

13 — + (M) -

FILAMENT CURRENT MONITOR
0-5V = 0-5Amps

9

PS COMMON
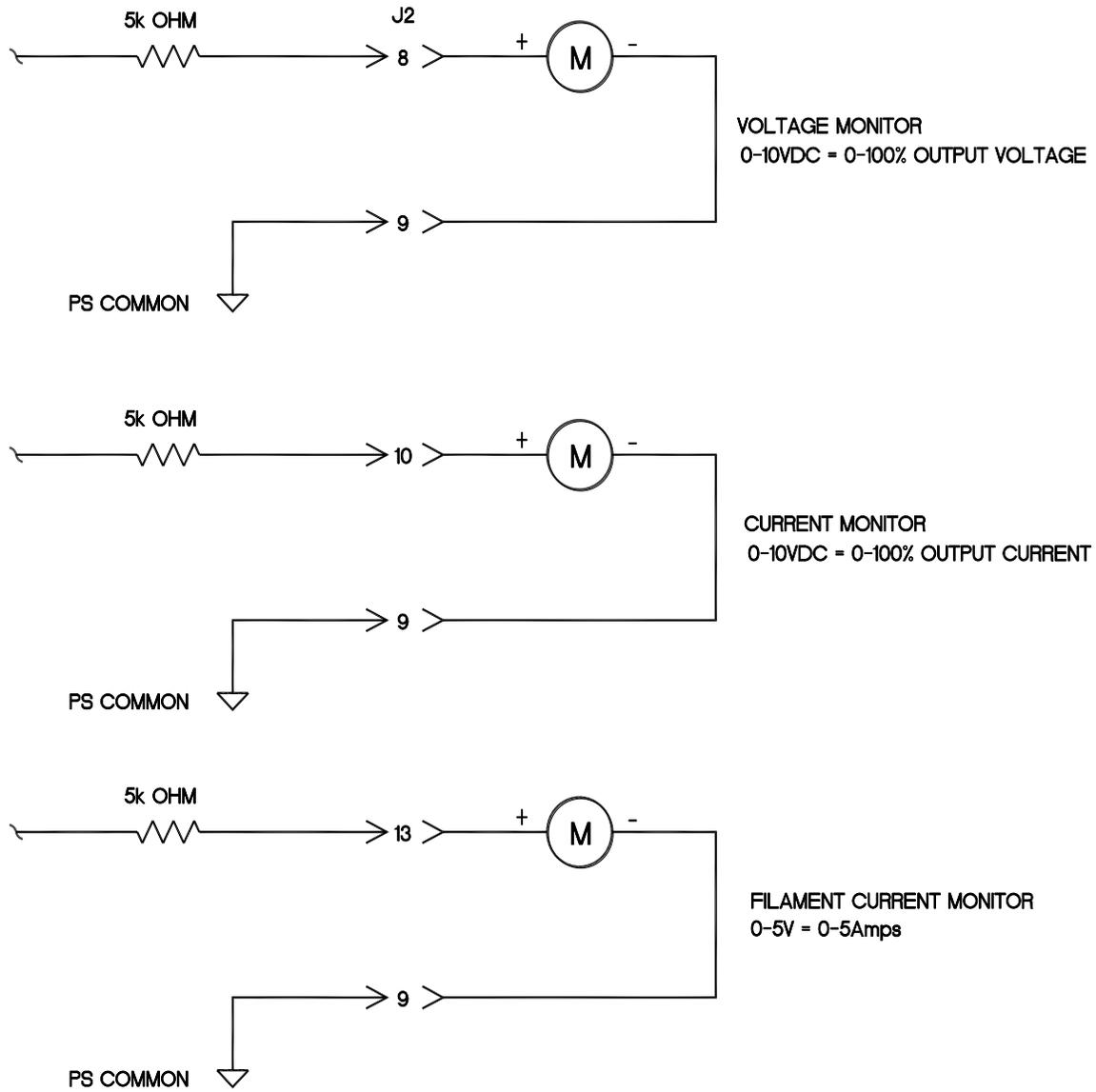
Figure 3.4 Remote Monitoring
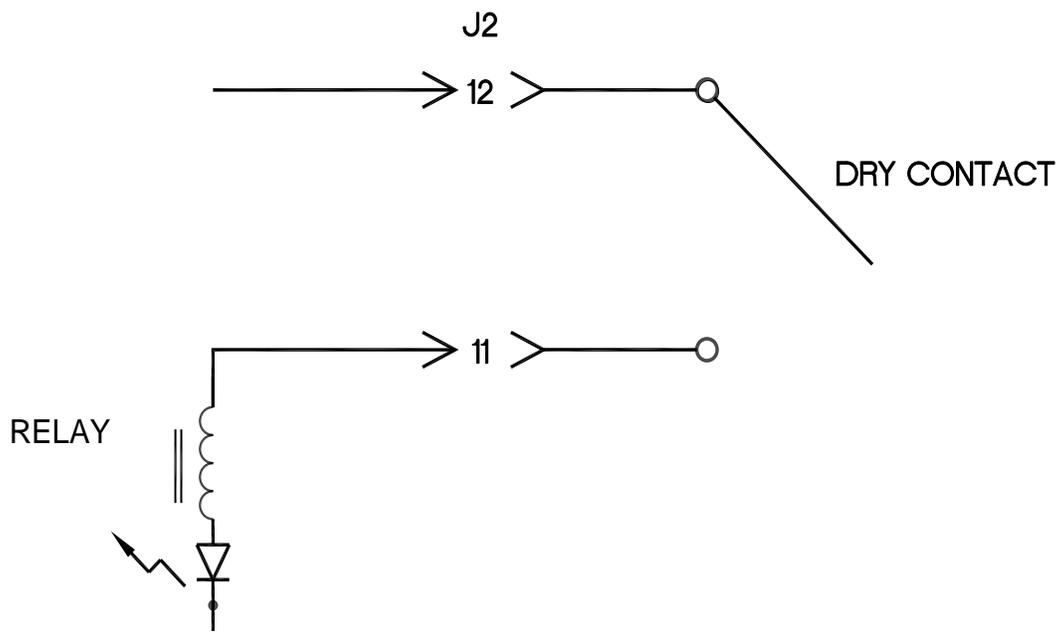
Figure 3.5 Enable/Interlock Logic Control

Chapter 4

PRINCIPLES OF OPERATION

The DXB Series of high voltage power supplies utilizes sophisticated power conversion technology. Advanced analog and power conversion techniques are used in the DXB series. The intention of the Principles of Operation is to introduce the basic function blocks that comprise the DXB power supply. For details on a specific circuit, consult Spellman's Engineering Department.

The DXB power supply is basically an AC to DC power converter. Within the power supply, conversions of AC to DC then to high frequency AC, then to high voltage DC take place.

Typical DXB power supplies comprise a few basic building blocks. These are: 1) AC to DC rectifier, 2) Power Factor correction boost circuitry 3) High frequency quasi-resonant inverter, 4) High voltage transformer and rectifier circuits, and 5) Control and monitoring circuits. The following is a brief description of each building block.

4.1 Power Factor and Associated Circuits

The DXB series can operate from 90 - 265VAC, for the 300Watt Model and 180 –264VAC for the 600 and 1200 Watt Models. The input voltage is connected via a typical IEC 320 type input connector. An internal EMI filter and fuse housing is an integral part of the DXB module. The input circuits actively correct the power factor.

The input line voltage is applied to a current limit device to reduce the initial inrush current. The input line voltage is converted to a 400VDC voltage via an active PFC Converter.

WARNING

The energy levels used and generated by the power supply can be lethal! Do not attempt to operate the power supply unless the user has a sufficient knowledge of the dangers and hazards of working with high voltage. Do not attempt to approach or touch any internal or external circuits or components that are connected or have been connected to the power supply. Be certain to discharge any stored energy that may be present before and after the power supply is used. Consult IEEE recommended practices for safety in high voltage testing #510-1983.

4.2 High Frequency Inverter

The DXB is a resonant converter operating in a zero current switching, series resonant, parallel loaded topology. MOSFET transistors switch the 400 VDC voltage to the resonant tank circuit. Typical operating frequency is in the range of 35-65kHz depending on model. Control of the resonant circuit output is done by the low voltage control circuits, and are isolated by an isolated pulse transformer. The output of the resonant circuit is applied to the primary of the high voltage transformer.

4.3 High Voltage Circuits

The high voltage transformer is a step-up type. The secondary of the high voltage transformer is connected to the high voltage rectifier circuit. The rectifier circuit will vary depending upon the rated output voltage. For lower power a half wave Cockroft-Walton multiplier is used, for higher power a full wave Cockroft-Walton multiplier is used. A feedback signal is generated by the high voltage resistor divider. This feedback signal is sent to control circuits to provide voltage regulation and monitoring. A current sense resistor is connected at the low voltage end of the rectifier circuit. The circuit sense signal is sent to the control circuits to provide current regulation and monitoring.

The high voltage rectifier output is connected to the output limiting resistors. These resistors limit the peak surge current in the event an arc or discharge occurs. The limiting resistor output is connected to the output connector provided.

4.4   Control Circuits

Control circuits are used for regulation, monitoring, pulse-width, control, slow-start and inhibit control. Feedback signals are calibrated and buffered via general purpose OP-AMPS. Pulse width control is accomplished by a typical PWM type control I.C. Logic enable/disable is provided by a logic gate I.C. Regulators generate +/- 15V and 10VDC. DSP based control circuitry provides excellent regulation, along with outstanding stability performance

```
┌─────────────────────────────────┐
│            WARNING              │
└─────────────────────────────────┘
```

LINE VOLTAGE IS PRESENT WHENEVER THE POWER SUPPLY IS CONNECTED TO EXTERNAL LINE VOLTAGES. BE SURE TO DISCONNECT THE LINE CORD BEFORE OPENING THE UNIT. ALLOW 5 MINUTES FOR INTERNAL CAPACITANCE TO DISCHARGE BEFORE REMOVING ANY COVER.

4.5 Options

Due to the variations of models and options provided in the DXB series, details of actual circuits used may differ slightly from above descriptions. Consult Spellman's Engineering Department for questions regarding the principles of operations for the DXB series.

Chapter 5

OPTIONS

THe options available for this power supply are described in this section. Interface diagrams are shown where required. Options are specified by including the option code in the model number as described in Section 1.4.

5.1 Custom Designed Models X (#)

Units built to customer specifications are assigned an X number be the factory. If this unit is an X model, specification control sheet is added at the end of this instruction manual.

Chapter 6

MAINTENANCE

This section describes periodic servicing and performance testing procedures.

<div align="center">

WARNING

</div>

THIS POWER SUPPLY GENERATES VOLTAGES THAT ARE DANGEROUS AND MAY BE FATAL.

OBSERVE EXTREME CAUTION WHEN WORKING WITH HIGH VOLTAGE.

6.1 Periodic Servicing

Approximately once a year (more often in high dust environments), disconnect the power to the unit.. Use compressed air to blow dust out of the inside of the unit. Avoid touching or handling the high voltage assembly.

6.2 Performance Test

<div align="center">

WARNING

</div>

**HIGH VOLTAGE IS DANGEROUS.
ONLY QUALIFIED PERSONNEL SHOULD
PERFORM THESE TESTS**.

High voltage test procedures are described in Bulletin STP-783, Standard Test Procedures for High Voltage Power Supplies. Copies can be obtained from the Spellman Customer Service Department. Test equipment, including an oscilloscope, a high impedance voltmeter, and a high voltage divider such as the Spellman HVD-100 or HVD-200, is needed for performance tests. All test components must be rated for operating voltage.

6.3 High Voltage Dividers

High voltage dividers for precise measurements of output voltage with an accuracy up to 0.1% are available from Spellman. The HVD-100 is used for voltages up to 100KV. The HVD-200 measures up to 200KV. The Spellman divider is designed for use with differential voltmeters or high impedance digital voltmeters. The high input impedance is ideal for measuring high voltage low current sources, which would be overloaded by traditional lower impedance dividers.

Chapter 7

FACTORY SERVICE

7.1 Warranty Repairs

During the Warranty period, Spellman will repair all units free of charge. The Warranty is void if the unit is worked on by other than Spellman personnel. See the Warranty in the rear of this manual for more information. Follow the return procedures described in Section 7.2. The customer shall pay for shipping to and from Spellman.

7.2 Factory Service Procedures

Spellman has a well-equipped factory repair department. If a unit is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached.

For all units returned for repair, please obtain an authorization to ship from the Customer Service Department, either by phone or mail prior to shipping. When you call, please state the model and serial numbers, which are on the plate on the rear of the power supply, and the purchase order number for the repair. <u>A Return Material Authorization Code Number (RMA Number) is needed for all returns</u>. This RMA Number should be marked clearly on the outside of the shipping container. Packages received without an RMA Number will be returned to the customer. The Customer shall pay for shipping to and from Spellman.

A preliminary estimate for repairs will be given by phone by Customer Service. A purchase order for this amount is requested upon issuance of the RMA Number. A more detailed estimate will be made when the power supply is received at the Spellman Repair Center. In the event that repair work is extensive, Spellman will call to seek additional authorization from your company before completing the repairs.

7.3 Ordering Options and Modifications

Many of the options listed in Chapter 5 can be retrofitted into Spellman power supplies by our factory. For prices and arrangements, contact our Sales Department.

7.4 Shipping Instructions

All power supplies returned to Spellman must be sent shipping prepaid. Pack the units carefully and securely in a suitable container, preferably in the original container, if available. The power supply should be surrounded by at least four inches of shock absorbing material. Please return all associated materials, i.e. high voltage output cables, interconnection cables, etc., so that we can examine and test the entire system.

All correspondence and phone calls should be directed to:

Spellman High Voltage Electronics Corp.
475 Wireless Boulevard
Hauppauge, New York 11788
TEL: (631) 630-3000 FAX: (631) 435-1620
E-Mail: sales@Spellmanhv.com
http://www.spellmanhv.com

To obtain information on Spellman's product warranty please visit our website at:

http://www.spellmanhv.com/en/About/Warranty.aspx

DXB Digital Interface Manual
Ethernet
Serial – RS-232
Universal Serial Bus - USB

118139-001 Rev C

USA   CHINA   EUROPE   JAPAN   MEXICO

Table Of Contents

THIS EQUIPMENT GENERATES DANGEROUS VOLTAGES THAT MAY BE FATAL. PROPER GROUNDING OF ALL HIGH VOLTAGE EQUIPMENT IS ESSENTIAL.SEE DXB OWNERS MANUAL FOR PROPER GROUNDING TECHNIQUE AND SAFETY PRECAUTIONS BEFORE APPLING AC INPUT POWER TO THE DXB UNIT.

TO PREVENT DAMAGE TO THE HOST COMPUTER THE COMPUTER SHOULD BE GROUNDED TO THE SAME GROUND AS THE UUT.

1.0   SCOPE

This document applies to the communications interfaces on the DXB , assembly 460067.

2.0   FUNCTIONAL DESCRIPTION

The DXB provides 3 different types of digital communications interfaces:

- RS-232 on J3
- Ethernet (10/100-Base-T) on J5
- Universal Serial Bus on J4.

3.0   GETTING STARTED - INTERFACE WIRING AND PIN-OUTS

3.1   RS232 INTERFACE

The RS232C interface has the following attributes:

- 115K bits per second
- No Parity
- 8 Data Bits
- 1 Stop Bit
- No handshaking
- DB-9 connector as shown

Pin 2: TX Out
Pin 3: RX In
Pin 5: GND
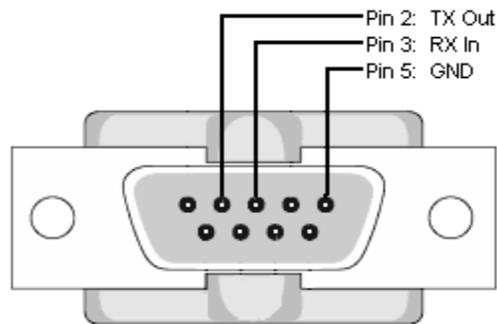
SIC Serial Port: DB-9 Male

Figure 1 – J3, RS-232 DB-9M pinout (front view)

PIN	DESCRIPTION
1	-
2	Tx Out
3	Rx In
4	-
5	Ground
6	-
7	-
8	-
9	-

3.2 ETHERNET INTERFACE

The Ethernet interface has the following attributes:
- 10/100-Base-T
- IP address can be set by the system integrator
- Network Mask can be set by the system integrator
- TCP Port Number can be set by the system integrator
- RJ-45 connector
- Network attachment via Crossover and Standard Ethernet cables.
- Supported Operating Systems: Windows 98 2ED, Windows 2000 (SP2), Windows NT (SP6), Windows XP Professional

LED 1 ⟶   ⟵ **LED 2**

8 7 6 5 4 3 2 1
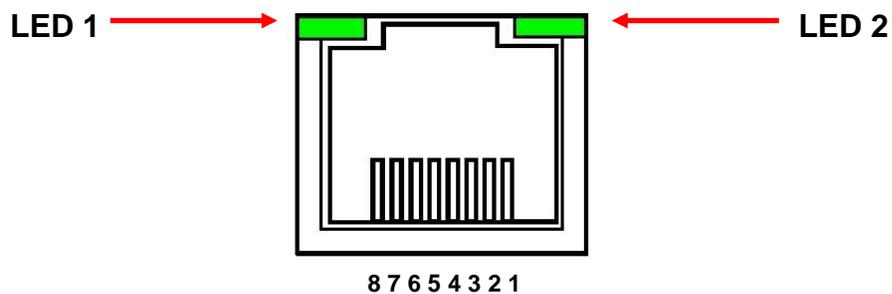
Figure 2 – J5, Ethernet RJ45 Jack (front view)

PIN	DESCRIPTION
1	TX+
2	TX-
3	RX+
4	-
5	-
6	RX-
7	-
8	-

The Ethernet RJ-45 has two LED indicators, as shown in Figure 2. The left LED, LED1 indicates that the network processor has a valid network link. The right LED, LED2 indicates network activity.

3.3 USB – UNIVERSAL SERIAL BUS INTERFACE

The USB interface has the following attributes:
- Compliant with USB 1.1 and USB 2.0 specifications
- Type B male connector
- Included driver can be communicated with via standard Windows serial communications methods
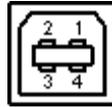
Figure 3 – J4, USB Type B (front view)

PIN	DESCRIPTION
1	Vbus +5V
2	D-
3	D+
4	Ground

3.4 RS-232 CABLING

A standard shielded RS-232 cable is used to connect the DXB serial port to the serial port on a standard personal computer. Please refer to the following chart.

PC to DXB Board Cable Details	
PC Connector (DB-9 Female)	DXB Connector (DB-9 Male)
Pin 2: RX In	Pin 2: TX Out
Pin 3: TX Out	Pin 3: RX In
Pin 5: Ground	Pin 5: Ground

3.5 ETHERNET CABLING

Unshielded Category 5e (CAT5e) Ethernet patch cables are used to connect the DXB to the host computer. There are two ways to connect to the DXB board via Ethernet: the first is to directly cable between the host and the DXB board, and the second is through the use of a switch, hub, or network. Although it is not recommended to use shielded cables, if a shielded Ethernet cable is used, it is advised to only connect the shield to Earth ground at one end of the Ethernet cable. This will prevent ground

loops and other isses from occurring that can cause data corruption. Please note the DXB's Ethernet connector's (J5) shell is connected Earth ground. The end user should conduct tests to determine the best method of grounding the cable shield for their application.

A direct connection requires a non-standard cable where the wires are not run straight through. Please refer to the two cable ends shown below in figure 4.
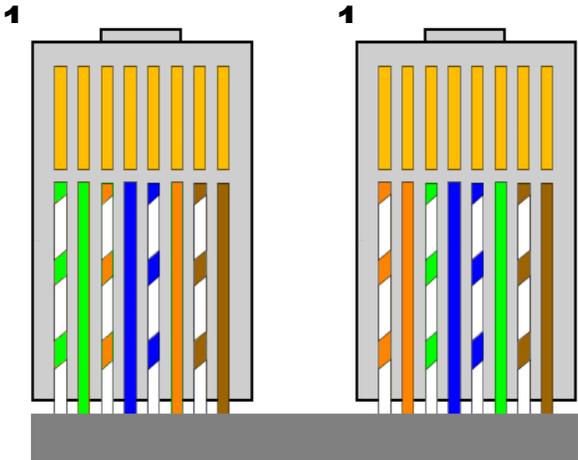
Figure 4 – Crossover Cable for Direct Connection

A standard connection through a hub, switch, or network uses a standard CAT5 patch cable. Please refer to the two cable ends shown below in figure 5.
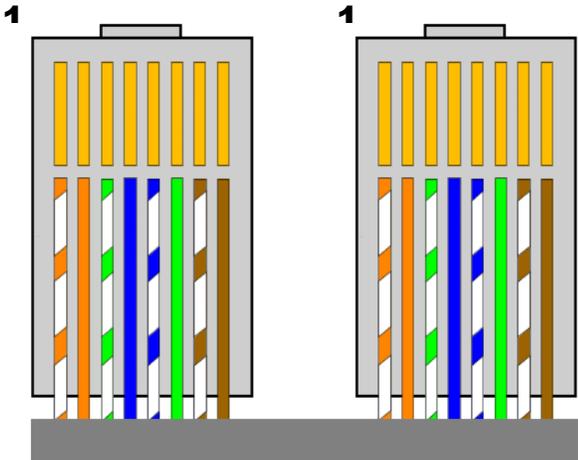
Figure 5 – Standard Straight Through Cable – Standard CAT5 Patch

3.6 USB CABLING

A high-quality double shielded USB 2.0 Type A to B (host to slave) cable should be used in all applications. This type of cable is a standard PC to peripheral cable that utilizes full-size connectors.

Figure 6 – USB A-to-B cable

3.6.1 HIGH EMI ENVIRONMENTS

If the DXB USB interface is being used in a high-EMI environment, ferrites should be added to the USB cable. Figure 7 illustrates the possible combinations of ferrites that can be used to achieve acceptable operation under these conditions.
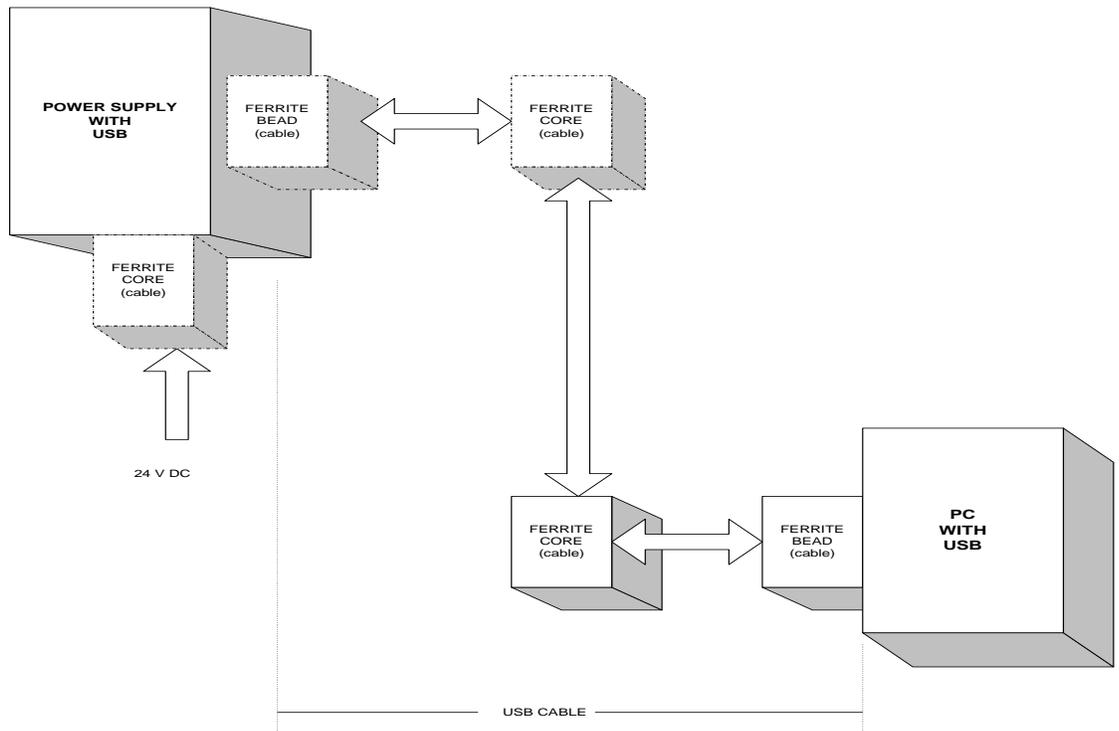
Figure 7 – Block Diagram of USB Cable Utilizing Ferrites

Ferrite beads should be attached to the USB cable next to the connectors – both sides should be installed. In extreme cases ferrite cores may be added where the cable is looped 3 or 4 times around the core as shown in figure 8. Cores of 1.5 to 2 inches should be used at both ends of the cable.

Figure 8 - Example of a USB Cable Using Ferrites

Please refer to the USB Interface Setup section, for an explanation of how USB works and why EMI may present a problem for this communications interface.

4.0   GETTING STARTED – SOFTWARE

The following sections detail how to create software to interface to the DXB communications interfaces.

4.1   RS-232

The RS-232 interface makes use of a standard 'command/response' communications protocol. See section 6.0 for the syntax of the serial interface protocol. The programmer should also review section 4.3 for programming considerations for the USB interface as the code is nearly identical for the RS-232 interface.

All software that addresses the RS-232 interface must adhere to the following parameters:

- A default Baud rate of 115.2K bps
- No Parity
- 8 Data Bits
- 1 Stop Bit
- No handshaking

The Baud rate can be changed to 115.2K ,57.6k,38.4k,19.2k or 9600 bps and stored in the unit.

4.1.1   Enabling Communications Objects in Visual Basic for RS-232

Communications in Microsoft Visual Basic 6.0 are directed to a control that abstracts the port. In the case of serial and USB we need Microsoft Comm Control 6.0. To enable this in your VB 6 project, go to:

Project -> Components

Then in the list make sure that Microsoft Comm Control 6.0 has a check next to it. The Comm Control Object should then appear in your toolbox. It will have an icon of a telephone and will be named: MSComm. This can be dragged and dropped into your application. You will then need to set the object's properties.

4.1.2   Configuring Communications in Visual Basic for RS-232

In order to configure the MSComm Object, first you must initialize it in the Object properties:

Settings   115200,n,8,1
Handshaking   0 – comNone

The application can be set to either default to a specific COM Port or the End User can be allowed to choose one for the particular

PC. For the "Default" scenario, include the following commands in the Form_Load() routine:

```
MSComm1.CommPort = portNumber
MSComm1.PortOpen = True
```

For the "Choice" scenario, place the above two commands in a selectable menu item.

4.2 ETHERNET

The DXB contains an embedded diagnostic web server that can be accessed through any standard web browser by browsing to the DXB's IP address. For example:

http://192.168.1.4

The Ethernet interface communicates using the following protocols:

- TCP/IP
- HTTP
- TFTP
- FTP

4.2.1 Diagnostic Web Server

The diagnostic web server can control and monitor an DXB equiped power supply from a web browser. It displays operating status of the Power Supply and allows the unit to be configured in real time. The application consists of three web pages; a page displaying contact information, a license agreement, and a monitoring and control applet that is at the heart of this application. The Web Server application for the DXB is presented as an example in the following pages.

4.2.2 Web Pages

4.2.2.1 Web Page 1: Contact Information Page

Figure 9 displays a picture of the DXB70N600 and information on how to contact Spellman High Voltage Electronics Corporation. By clicking on the picture of the DXB70N600 or on the button labeled "Click Here to Monitor and Control" one can move on to the next screen, the license agreement.

Figure 9 - Web Page 1- Contact Information

4.2.2.2 Web Page 2: License Agreement Page

Figure 10 displays the license agreement. Here the user can either agree or disagree with the Spellman license agreement. Click on "I Accept" to continue on to the applet.
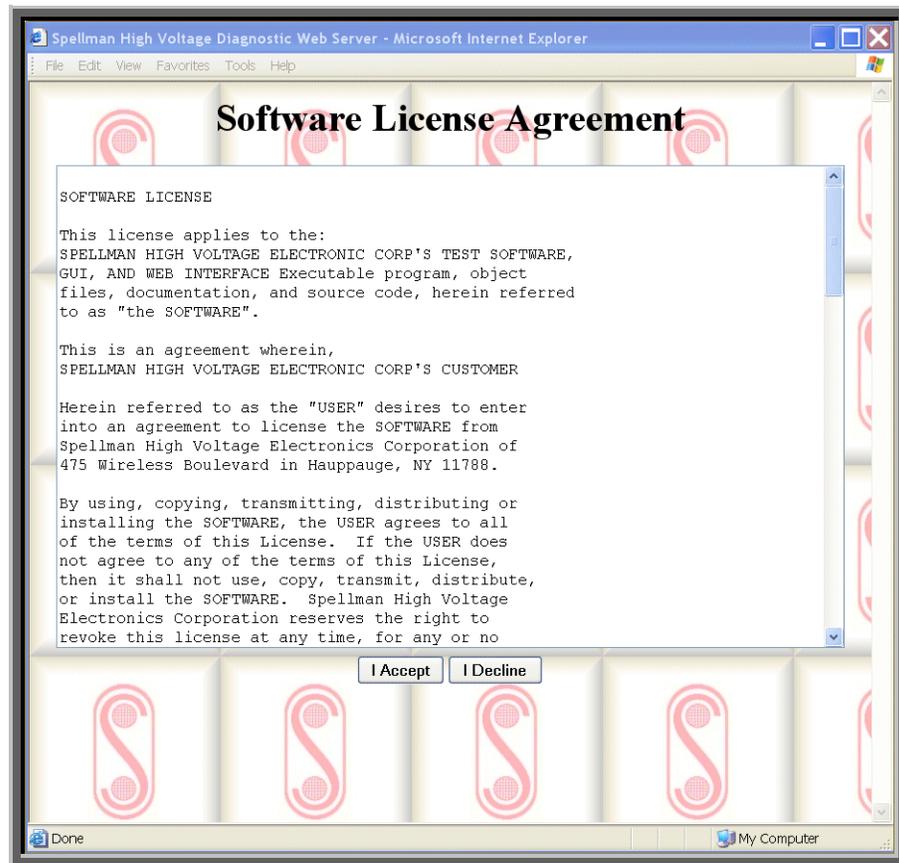
Figure 10 - Web Page 2 – License Agreement

4.2.2.3　Web Page 3 - Monitor and Control Applet

4.2.2.3.1　Requirements

The Monitor and Control Applet is a java "applet" ("small java application" specifically written to be embedded in a web page and invoked from a browser) that requires an Internet browser with an installed JVM (Java Virtual Machine). The Default username and password for the applet is: Username: admin, Password: SHV_Applet. We have tested under Internet Explorer 5 and 6, Microsoft JVM 5 and Sun JVM versions 1.4.1 and 1.4.2.

4.2.2.3.2　Description of Monitor and Control Applet

Figure 11 displays an example of an embedded monitor and control application.
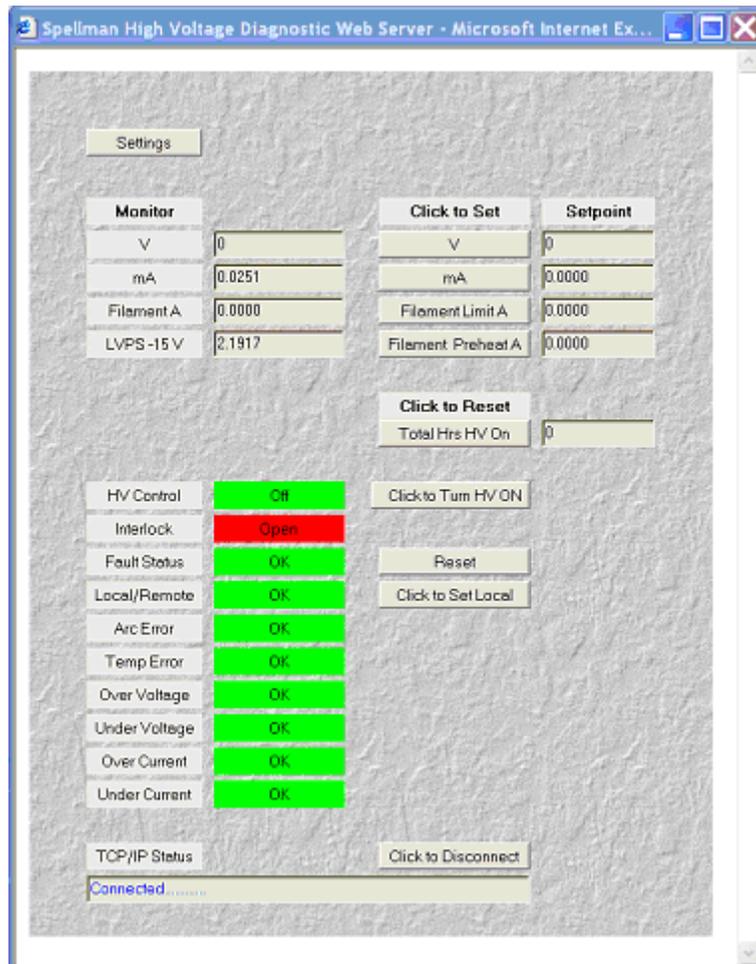
Figure 11 - Control and Monitor Applet

Broadly one can view the screen as a "left" and a "right" with the left half containing status values (read backs) read from

the DXB and the right half containing the values that are configurable by the user. Notice that the top of the right half contains the label "Click to Set". For any configurable setting you click on the button to the left of the setting, which brings up the program set point screen. For example, click on the button labeled, 'V' to set the output voltage set point. Refer to figure 12.

4.2.2.4 Program Set Point Screen

On the program set point screen (Reference figure 12 there are two fields: a top field labeld 'V' and a bottom field labeled 'DAC'.
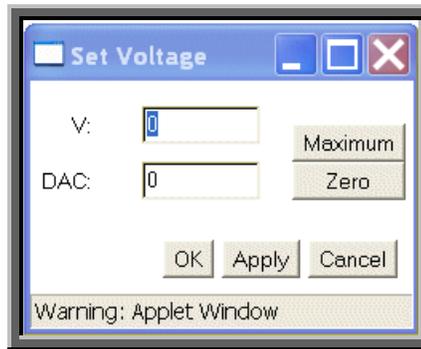
Figure 12 - Program Configurable Values Screen

The top field is the scaled value or real world value, which is the field the user is going to use most of the time. The bottom field is the raw digital-to-analog converter (DAC) value that is actually sent to the DXB. Enter either the desired set point level in the top field or the DAC value between 0 and 4095 in the bottom field.

The user can then click Apply to send the set point to the DXB and remain in the set point screen, or click OK to send the set point and close the set point entry window. The Maximum and Zero buttons will set both fields to the indicated end point value. The user may also click on Cancel to close the window without sending any changes.

To reset the Total hour On meter to zero via the Applet a password is required.The password is "SHV_Reset"

4.2.2.5 Java Warning Messages

You may notice a message at the bottom of all dialog windows that are displayed from the DXB Control and Monitor Applet. The wording may vary slightly depending on the JVM version but on some the message is "Warning: Applet Window". This message is letting you know that the dialog window was generated by an applet. The design philosophy for the JVM was for secure

computing so the origins of new windows are supposed to be as obvious as possible.

4.2.2.6 Menu Item "Settings" on Applet

The user can view and set operating parameters of the applet or network configurations of the DXB or view firmware version information for both through the settings menu. Click on the button at the top of the Monitor and Control Applet that has the label "Settings". This displays the settings popup menu as shown in figure 13.

Figure 13 – Settings Pop up Menus

Notice that there are three choices. The first, "Network Settings" refers to the network settings for the network component of the DXB and not the Monitor and Control applet. The second option, "Poll Rate" affects refresh rate of the Monitor and Control Applet and will be discussed in the next section. In the "about" choice firmware version information is displayed, both for the Monitor and Control Applet and for the DXB hardware.

4.2.2.7 Refresh rate for monitored values

The refresh rate for the applet display of the DXB is dependent upon the rate of placement of status requests in the internal send queue and how fast responses are sent back from the DXB in response to the requests. The default value for queuing responses is every 600ms and this is a configurable value in the

Settings->Poll rate screen. Please refer to figure 14.

Figure 14 - Configure Polling Rate Screen

Setting this value lower may make the screen refresh quicker. However, setting it too low may cause requests to queue up in the send queue. This may make controlling the DXB very slow, as control requests now must wait behind queued status requests. We recommend leaving the delay set at the default value.

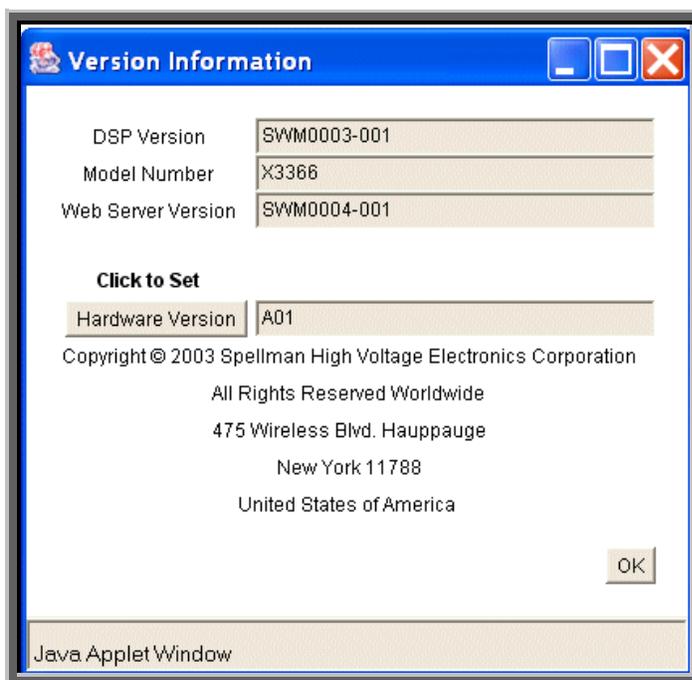### 4.2.2.8   Version Information

Figure 15 – Version Information

4.2.2.9   Turning the DXB HVOn/Off and Connection Status

Please refer to Figure 11, the Monitor and Control Applet.

Setting Name	**Range Values**
Local/Remote	Local mode/Remote mode
HV	On/Off
Interlock	Open/Closed
Fault Status	OK/Fault

Connection Status   Connected/No Data Received/Disconnected

Unlike the controls we previously discussed at the top of the screen which required a separate dialog screen to enter values, these are controlled by a button. For example, an On/Off button controls the HV. When HV is on, the Control is labeled "Click to Turn HV Off". When HV is off, the control is labeled "Click to Turn HV On". Thereby handling the two distinct states.

Notice that at the very bottom of the screen is a text field that displays the current connection status, which as mentioned above is one of three values. "Connected" is displayed when there exists a valid TCP/IP session connecting the DXB and the Applet and data is being received by the applet from the DXB. The next state is "No Data Received" which is when there is still a valid connection but no responses have been received from the DXB for 2 seconds. Lastly, the text field displays "Disconnected" when the TCP/IP session has been disconnected.To operate the UUT using the Computer interface the UUT must be set to Remote Mode by Clicking "Click to Set Remote.

When the Applet is first started and anytime the "Click To Connect" button is clicked there is a 5 second delay as the Applet starts up the threads necessary for communication between it and the DXB.

4.2.2 Direct Connection between the DXB and a Computer

A direct Ethernet connection between the DXB and the computer requires an RJ45 crossover cable. The end connectors will look identical to a "normal" RJ45 connector but the colors of some of the wires in the connectors will be "reversed". Hold up the two ends of the RJ45 cable and look at the color of the wires from left to right. They should differ on the two connectors.

When direct connecting the DXB to a computer using a crossover cable over Ethernet they are essentially participating in a private network. As such you need to pick two valid IP addresses, one for each device.

The table below illustrates that not all IP addresses are actually valid IP addresses. For example, IP addresses beginning with 127 are not valid.

Class	Address Range
A	1.0.0.0-126.255.255.255
B	128.0.0.0-191.255.255.255
C	192.0.0.0-223.255.255.255

4.2.2.1 Configuring the Computer for Direct Ethernet Connection

As mentioned above both the IP Address and Subnet Mask need to be configured. In our environment computers normally are assigned IP addresses dynamically, using DHCP. We need to change this and assign the IP Address statically to the one we have selected.

Here are the steps on Windows XP. On the desktop right click on "My Network Places" and select properties at the bottom of the menu.

Figure 16 – Right Click on Desktop

Figure 17 – Select Properties

After selecting properties you are brought up to the screen below (Figure 18). You must RIGHT CLICK and select Properties on Local Area Connection, and not double click which will display a window similar to figure 19.

Figure 18 – Here you must Right Click and Select Properties
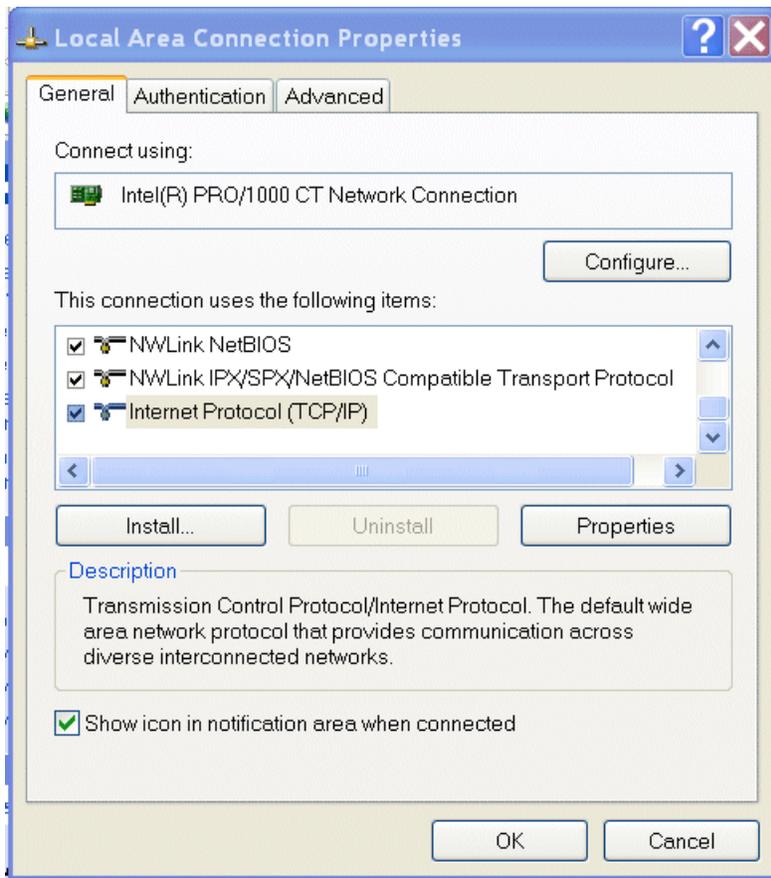
Figure 19 – Local Area Connection Properties

Now you must select "Internet Protocol (TCP/IP)" and click on the Properties button to be brought to figure 20. Lastly you must disable any firewall software you have running. If you are running a proxy server for Internet access, you must also disable the proxy client. Disabling this also requires a reboot.
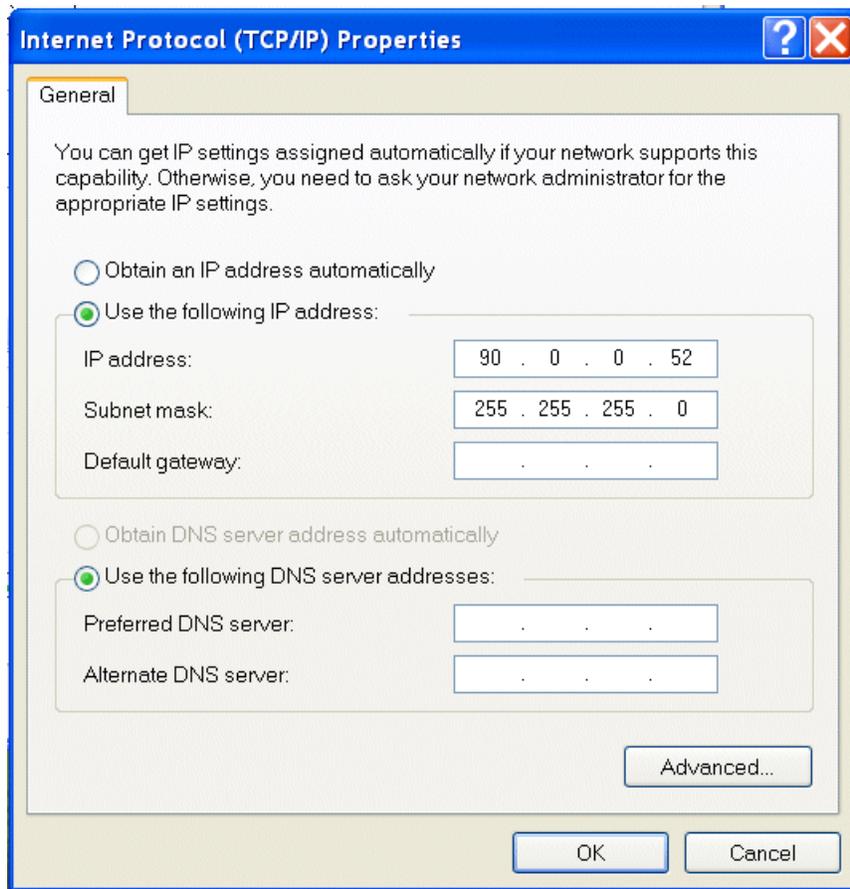
Figure 20 – TCP/IP Properties

4.2.2.2 Testing a Direct Connection

You can use the program "Ping" to test a network connection between the computer and the DXB. "Ping" is a command line tool so we will need to bring up a command prompt. Under Windows NT, 2000 and XP the name of this command is "CMD". Under Windows 98 the name of this command is "Command".

To do this, click on Start->Run->Cmd

Then on the command line type

Ping <IP Address>

For example

Ping 192.168.1.4

If the DXB is found at the specified IP address, the Ping command will respond with a report that is similar to:

Pinging 192.168.1.4 with 32 bytes of data:

Reply from 192.168.1.4: bytes=32 time<1ms TTL=64

Reply from 192.168.1.4: bytes=32 time<1ms TTL=64

Reply from 192.168.1.4: bytes=32 time<1ms TTL=64

Reply from 192.168.1.4: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.1.4:

   Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

   Minimum = 0ms, Maximum = 0ms, Average = 0ms

4.2.3 Configuring the DXB For a Local Area Network (LAN)

If you have chosen to place the DXB onto your local area network you will need:

- A CAT5 network patch cable to physically connect the DXB to the LAN

- A static IP address to assign to the DXB.

Remember that even if the IP address you have selected is in general a valid IP address it needs to be valid for your LAN (local area network). Otherwise the device will not be accessible from an Internet browser or Ping.

4.2.3.1 Configuring the Network Settings from the Monitor and Configure Applet

The network settings are configurable from the Settings->Network Settings screen, refer to figure 21.
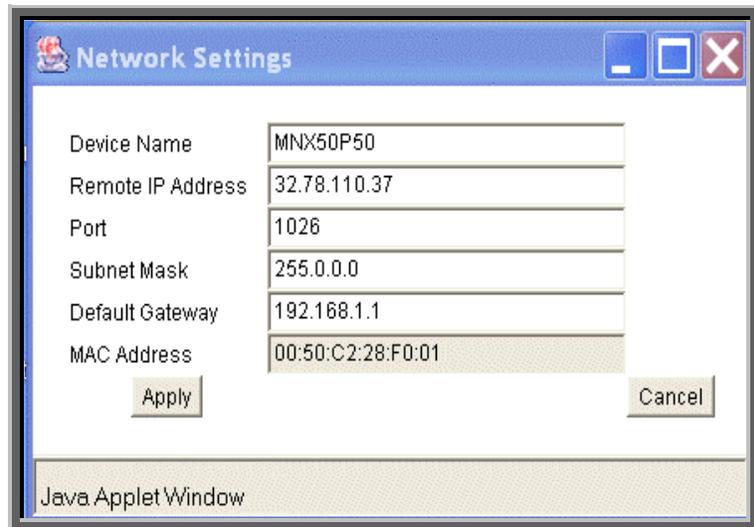
Figure 21 - Configure Network Settings

The settings that can be changed are the:

- Device Name

- IP Address

- TCP Port

- Subnet Mask

- Default Gateway

Once the Apply button is clicked on the network settings screen the network component of the DXB is configured, rebooted and the applet is disconnected from the DXB. You must type the NEW IP address into a web browser to bring up a new instance of the applet to monitor and control the DXB after reconfiguring it. This may also require reconfiguring the host computer with the correct host IP address, subnet mask, and TCP port.

The device name does not affect the operation of the DXB; it is simply a way for the user to differentiate multiple units on the same network.

Depending on the type of network you are attaching the DXB to, you may need to configure the host PC's IP address and subnet mask as shown in section 4.2.2.1. You can also test a network connection to the DXB by following the instructions listed in section 4.2.2.2.

4.2.4 Enabling Communications Objects in Visual Basic for Ethernet Communications

For Ethernet communications, we need Microsoft Winsock Control 6.0 and SP5. To enable this in your VB 6 project, go to:

Project -> Components

Once selected in your toolbox you will have an icon of two computers linked together and it will be named: Winsock.This can be dragged and dropped into your application. Then set the object's properties.

4.2.5 Configuring Communications in Visual Basic for Ethernet

In order to configure the Winsock Object, you must make the following initialization in the object's properties:

Protocol   0 – sckTCPProtocol

Then, in the application code, include the following commands:

tcpClient.RemoteHost = host
tcpClient.RemotePort = portNumber
tcpClient.Connect

For further information regarding the use of the above commands, please refer to your Visual Studio Help File.

4.2.5.1   Data Output Example

MSComm1 is both the serial and USB port. TcpClient is the Ethernet port.

```
If (portType = "ethernet") Then
        tcpClient.SendData (str)
Else
        MSComm1.InBufferCount = 0
         On Error GoTo done
        MSComm1.Output = str
        done:
        tmrOpenClose.Enabled = True
End If
```

4.2.5.2   Data Input Example

```
If (portType = "ethernet") Then
        Do
                DoEvents
tcpClient.GetData temp$
```

```
                        str = str + temp$
                        Loop Until InStr(str, Chr(3)) Or Timer - t1 > 1
                        On Error Resume Next
                Else
                        Do

                        DoEvents
                        If MSComm1.InBufferCount > 0 Then
                                str = str & MSComm1.Input
                        End If
                        Loop Until InStr(str, Chr(3)) Or Timer - t1 > 1
                        If InStr(str, Chr(3)) > 0 Then
                                tmrOpenClose.Enabled = False
                        End If
                End If
```

4.3 USB

The USB interface makes use of a standard 'command/response' communications protocol. See section 6.0 for the syntax of the serial interface protocol.

The USB interface is accessed through a Windows USB Human Interface driver (HID).

4.3.1 USB Driver Installation

The HID driver is a Windows driver installed with the operating system. To determine if the driver had been acquired open the System properties window selecting the Control Panel System Properties.

Figure 22 – System Properties

Then select Device Manager and expand the Human Interface Devices. View the properties of the USB Human Interface Device icon and verify that Spellman USB HID appears in the Location section.
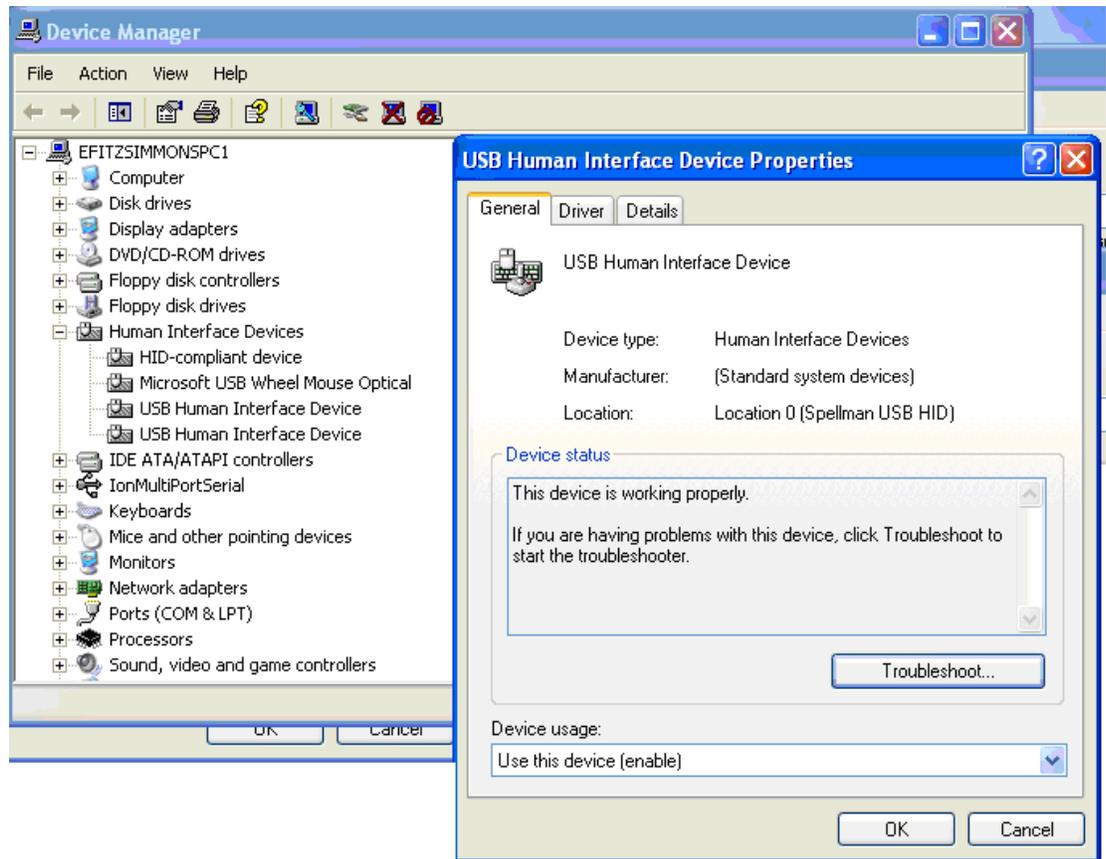
Figure 23 – Device Manager showing USB HID

4.3.2 USB and EMI

The USB protocol utilizes a heartbeat signal from each client device back to the host (PC). If the heartbeat is interrupted due to radiated or conducted transient noise, it is possible that the host may lose connection with the client. This can cause problems with data transfers over the USB cable.

The DXB when used in combination with the HID Windows driver makes it possible for the host to renumerate the client connection and reestablish communications. This is providing the control application implements a method of timeout and retry.

NOTE: If an EMI disruption occurrs the DXB will continue to renumerate until a connection with the GUI is re-established.

4.3.3   Enabling Communications Objects in Visual Basic for USB

The dynamic link library USB_dll.dll will be provided which needs to be added to the project. The library has three functions that can be called from the VB code.

The three functions are:
- FindTheHid – finds the connection with the correct VID, PID and Serial Number
- WriteReport(str) – Writes a string to the connected HID interface
- ReadReport() – Returns a string from the connected HID interface

4.3.4   Configuring Communications in Visual Basic for USB

To use the USB_dll.dll in VB the following statements are needed.

Dim usb As usbDll
Dim MyDeviceDetected As Boolean

Set usb = New usbDll

Using this statement determines whether a connection is present.

MyDeviceDetected = usb.FindTheHid

If MyDeviceDetected is true then the connection is present.

4.3.5   Software Considerations for USB Reconnection

The following Visual Basic code snippets are presented as a guideline for implementation with revision C and higher assemblies.

4.3.5.1   Recognize partial, corrupt, or absent data

```
1:  temp2$ = inputInputString
2:  If temp2$ <> "" Then
3:      btn_UPDATEDATA.Value = False
4:      CommStatusFlag = True
5:      CommaPos = InStr(Start, temp2$, Comma, vbTextCompare)
6:      ' Channel 0
7:      On Error GoTo endhere
8:      AmbTemp = Mid(temp2$, Start, (CommaPos - Start))
```

Please note that even though we have guarded against no data, in line 2, we still need to guard against bad data, in this case no comma, on line 8. If there is no comma, we wind up passing a negative value to Mid, which is an error, that we should trap for.

4.3.5.2   Retrieve data only if it exists

```
1:  Do
2:      DoEvents
3:      If MSComm1.InBufferCount > 0 Then
4:              str = str & MSComm1.Input
5:      End If
6:      Loop Until InStr(str, Chr(3)) Or Timer - t1 > 1
7:      'str = str & MSComm1.Input
8:      If InStr(str, Chr(3)) > 0 Then
9:              tmrOpenClose.Enabled = False
10:     End If
```

Notice that in line 3 we check for the existence of data before we extract data from the USB port. Normally, if there is no data, line 4 would append an empty string. However, during a noise event, retrieving data without first checking the existence of data could hang.

4.3.5.3   Example Output Routine

Notice that on line 13 we register an error handler in case the port is invalid because we have closed it in another routine. Notice that on line 16 we start a timer. When we output data on the port we start a timer to keep track of incoming data. If we get no incoming data it means that communications have been interrupted.

```
1: Private Sub outputOutputString(outputString As String)
2:   Dim str As String
3:   str = ProcessOutputString(outputString)
4:   StatusBar1.Panels(4).Text = "TX: " & str
5:   'StatusBar1.Panels(3).Text = "RX: Waiting"
6:   If (portType = "ethernet") Then
7:    tcpClient.SendData (str)
8:   ElseIf (portType = "USB") Then
9:     usb.WriteReport (str)
10:   Else
11:      MSComm1.InBufferCount = 0
12:
13:   On Error GoTo done
14:      MSComm1.Output = str
15: done:
16:      tmrOpenClose.Enabled = True
17:   End If
18: End Sub
```

4.3.5.4　　　Example Input Routine

Notice on line 26 we check for data first before extracting data from the input. Then if we have actual data we turn off the timer. Otherwise the timer routine toggles the port open/close.

```
1: Private Function inputInputString() As String
2:    Dim str As String
3:    Dim t1 As Single
4:   Dim temp$

5:    Dim stra As String
6:    Dim stri(300) As String

7:    t1 = Timer
8:
9:   If (portType = "ethernet") Then
10:       Do
11:          DoEvents
12:          tcpClient.GetData temp$
13:          str = str + temp$
14:       Loop Until InStr(str, Chr(3)) Or Timer - t1 > 1
15:       On Error Resume Next

16:    ElseIf (portType = "USB") Then
17:       Do
18:          DoEvents
19:        stra = usb.ReadReport
20:        str = str & stra
21:         'str = str & ReadReport
22:       Loop Until InStr(str, Asc(3)) Or Timer - t1 > 0.09

23:    Else
24:      Do
25:         DoEvents
26:        If MSComm1.InBufferCount > 0 Then
27:            str = str & MSComm1.Input
28:        End If
29:      Loop Until InStr(str, Chr(3)) Or Timer - t1 > 1
30:
31:      If InStr(str, Chr(3)) > 0 Then
32:         tmrOpenClose.Enabled = False
33:      End If
34:
35:      frm_EXTRAS.txt_MSCOMMBUFF.Text = str
36:      tmr_COMMWDT.Enabled = True
37:       On Error Resume Next
```

38:    End If
39:    StatusBar1.Panels(3).Text = "RX: " & str
40:    inputInputString = str
41:    tmr_RCVTIMER.Enabled = True
42: End Function

4.3.5.5 Example Timer Routine: Toggle Port State

This is the timer routine in which the open/closed state of the port is toggled. If communications are interrupted, the USB device will re-register itself with the OS (vendor term: renumeration). Once this happens, re-opening the port will enable communications. Until the re-registration happens, open operations will fail. Notice line 5 where we register an error handler.

```
1:Private Sub tmrOpenClose_Timer()
2:  If MSComm1.PortOpen = True Then
3:
4:      MSComm1.PortOpen = False
5:      On Error GoTo done
6:      MSComm1.PortOpen = True
7: done:
8:      tmrOpenClose.Enabled = False
9:   End If
10:
11: End Sub
```

4.3.5.6 Example Timer Routine: Port Reconnection

This is another timer routine whose purpose is to turn the port on if it is off. Notice that in line 8 an error handler is called because if the device has not re-registered itself with the OS, an error will be raised.

```
1: Private Sub tmr_COMMWDT_Timer()
2:
3: tmr_COMMWDT.Enabled = False
4:
5: If CommStatusFlag = True Then
6:
7:   If MSComm1.PortOpen = False Then
8:      On Error GoTo done
9:      MSComm1.PortOpen = True
10: done:
11:   End If
12:
13: ElseIf CommStatusFlag = False Then
14:
```

```
15:    If MSComm1.PortOpen = False Then
16:
17:        MSComm1.PortOpen = True
18:    Else
19:        MSComm1.PortOpen = False
20:    End If
21:
22: End If
```

4.3.5.7   Data Parsing Example

Here we have an example of a code that parses incoming data. Notice that it makes use of our generic input and output routines. The important consideration is to gracefully handle corrupted input data after a noise event. In this case we may get data, so a test against empty string returns false, but we may not get commas in the correct place. Notice that we register an error handler on line 26 so that the mid function, which would raise an error when given a negative number, is handled.

```
1: Private Sub btn_EMI_Click()
2:   Dim temp2$
3:    Dim Response1$
4:    Dim Response2$
5:    Dim number$
6:    Dim Comma
7:    Dim CommaPos
8:    Dim Start
9:    Dim ODATA$
10:
11: Comma = ","
12: Start = 5
13:
14: If tmr_RCVTIMER.Enabled = True Then
tmr_RCVTIMER.Enabled = False
15: If tmr_NETRCVTMR.Enabled = True Then
tmr_NETRCVTMR.Enabled = False
16:
17: If AutoUpdate = True Then
18:    tmr_UPDATE.Enabled = False
19: End If
20:
21:    number$ = "15,"
22:    outputOutputString (number$)
23:
24:    temp2$ = inputInputString
25:    CommaPos = InStr(Start, temp2$, Comma, vbTextCompare)
```

```
26:    On Error GoTo endhere
27:    Response1$ = Mid(temp2$, Start, (CommaPos - Start))
28:
29:    'With a 5v reference:
30:    ODATA$ = Format(str(Response1$ * 0.0004884), "0.##0")
31:
32:  txt_DACB.Text = ODATA$ + " mA"
33:    frm_RAWDATA.txt_RAWDACB.Text = str(Response1$)
34:    txt_DACB.BackColor = vbWhite
35:    CommStatusFlag = True
36: endhere:
37:
38: If portType = "ethernet" Then
39:   tmr_NETRCVTMR.Enabled = True
40: Else
41:    tmr_RCVTIMER.Enabled = True
42: End If
43:
44: If AutoUpdate = True Then tmr_UPDATE.Enabled = True
46: End Sub
```

5.0   ETHERNET COMMANDS

5.1   TCP/IP FORMAT

Each Ethernet command will consist of a TCP/IP header followed by the required data bytes. Figure 27 summarizes the TCP/IP header configuration. Please note that this functionality is provided by the software implementation of the Open Systems Interconnection (OSI) TCP/IP protocol stack, specifically the upper 4 layers.

Byte									
0	Protocol Version	Header Length		Type Of Service		Total Length			
4	Packet ID					Flags	Fragmentation Offset		
8	Time To Live			Protocol		Header checksum			
12	Source Address								
16	Destination Address								
20	Source Port					Destination Port			
24	Sequence Number								
28	Acknowledgement Number								
32	Data Offset	Reserved		Code Bits		Window			
36	Checksum					Urgent Pointer			
40	Data Byte 1		Data Byte 2		Data Byte 3		Data Byte N		

Figure 24: Network TCP/IP datagram header

The format of Data Bytes 1 through N are as follows:

<STX><CMD><,>ARG><,><ETX>

Where:
<STX>   = 1 ASCII 0x02 Start of Text character
<CMD>   = 2 ASCII characters representing the command ID
<,>   = 1 ASCII 0x2C character
<ARG>   = Command Argument
<,>   = 1 ASCII 0x2C character
<ETX>   = 1 ASCII 0x03 End of Text character

5.2   COMMAND ARGUMENTS

The format of the numbers is a variable length string. To represent the number 42, the string '42', '042', or '0042' can be used. This being the case, commands and responses that carry data are variable in length.

5.3   COMMAND OVERVIEW

Data Byte section of the TCP/IP Datagram			
Command Name	<CMD>	<ARG>	RANGE
Program RS-232 unit baud rate	07	1 ASCII	1 - 5
Program kV	10	1-4 ASCII	0-4095
Program mA	11	1-4 ASCII	0-4095
Program Filament Limit	12	1-4 ASCII	0-4095
Program Filament Pre-Heat	13	1-4 ASCII	0-4095
Request kV Setpoint	14	None	-
Request mA Setpoint	15	None	-
Request Filament Limit Setpoint	16	None	-
Request Filament Pre-Heat Setpoint	17	None	-
Request Analog Monitor Readbacks	19	None	-
			-
Request HV On Hours Counter	21	None	-
Request Status	22	None	-

Request Software Version	23	None	-
Request Hardware Version	24	None	-
Request Web Server Version	25	None	-
Request Model Number	26	None	-
Reset HV On Hours Counter	30	None	-
Reset Faults	31	None	-
Request Network Settings	50	None	-
Program Network Settings	51	6 ASCII	See Description
Request kV monitor	60	None	-
Request mA monitor	61	None	-
Request Filament Feedback	62	None	-
Request Filament Limit	63	None	-
Request Filament Pre-Heat	64	None	-
Request –15V LVPS	65	None	-
			-
Program Local/Remote Mode	99	1 ASCII	0 or 1

5.4 RESPONSE OVERVIEW

The command responses will follow the same network TCP/IP header format as outlined above in section 5.1. This list is comprised of Commands with complex responses only. Commands using a simple response will use the <$> character (ASCII 0x24) as a "Success" response or a single character error code. These will be seven ASCII characters in length.

Response Name	<CMD>	Response
Request kV Setpoint	14	10 ASCII
Request mA Setpoint	15	10 ASCII
Request Filament Limit Setpoint	16	10 ASCII
Request Filament Pre-Heat Setpoint	17	10 ASCII
Request Analog Monitor Readbacks	19	23-50 ASCII
Request Total Hours High Voltage On	21	13 ASCII
Request Status	22	11 ASCII
Request DSP Software Version	23	17 ASCII
Request Hardware Version	24	9 ASCII
Request Web Server Version	25	17 ASCII
Request Model number	26	11 ASCII
Request Network Settings	50	48-104 ASCII
Read Interlock Status	55	11 ASCII
Request kV monitor	60	7-10 ASCII
Request mA monitor	61	7-10 ASCII
Request Filament Feedback	62	7-10 ASCII

Request –15V LVPS	65	7-10 ASCII
Request Faults	68	6 ASCII

5.5 COMMAND STRUCTURE

5.5.1 Program kV

Description:
The host requests that the firmware change the setpoint of kV.

Direction:
Host to supply

Syntax:
<STX><10><,><ARG><,><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>10,4095,<ETX>

Response:
<STX><10><,><$><,><ETX>
<STX><10><,><ARG><,><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

5.5.2 Program mA

Description:
The host requests that the firmware change the setpoint of mA.

Direction:
Host to supply

Syntax:
<STX><11><,><ARG><,><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>11,4095,<ETX>

Response:
<STX><11><,><$><,><ETX>
<STX><11><,><ARG><,><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

5.5.3 Program Filament Limit

Description:
The host requests that the firmware change the setpoint of Filament Limit.

Direction:
Host to supply

Syntax:
<STX><12><,><ARG><,><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>12,4095,<ETX>

Response:
<STX><12><,><$><,><ETX>
<STX><12><,><ARG><,><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

5.5.4 Program Filament Pre-Heat

Description:
The host requests that the firmware change the setpoint of Filament Pre-Heat.

Direction:
Host to supply

Syntax:
<STX><13><,><ARG><,><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>13,4095,<ETX>

Response:
<STX><13><,><$><,><ETX>
<STX><13><,><ARG><,><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

5.5.5 Request kV Setpoint

<u>Description:</u>
The host requests that the firmware report the kV setpoint.

<u>Direction:</u>
Host to supply

<u>Syntax:</u>
<STX><14><,><ETX>

<u>Response:</u>
<STX><14><,><ARG><,><ETX>

<u>Where:</u>
<ARG> = 0 - 4095 in ASCII format

<u>Example:</u>
<STX>14,4095,<ETX>

5.5.6 Request mA Setpoint

<u>Description:</u>
The host requests that the firmware report the current mA setpoint.

<u>Direction:</u>
Host to supply

<u>Syntax:</u>
<STX><15><,><ETX>

<u>Response:</u>
<STX><15><,><ARG><,><ETX>

<u>Where:</u>
<ARG> = 0 - 4095 in ASCII format

<u>Example:</u>
<STX>15,4095,<ETX>

5.5.7 Request Filament Limit Setpoint

Description:
The host requests that the firmware report the current Filament Limit setpoint.

Direction:
Host to supply

Syntax:
<STX><16><,><ETX>

Response:
<STX><16><,><ARG><,><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>16,4095,<ETX>

5.5.8 Request Filament Pre-Heat Setpoint

Description:
The host requests that the firmware report the current Filament Pre-Heat setpoint.

Direction:
Host to supply

Syntax:
<STX><17><,><ETX>

Response:
<STX><17><,><ARG><,><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>17,4095,<ETX>

5.5.9 Request Analog Monitor Readbacks

Description:
The host requests that the firmware transmit the present values of Analog Monitor Readbacks.

Direction:
Host to supply

Syntax:
<STX><19><,><ETX>

Example:
<STX><19>,<ETX>

Response:
<STX><19><,><ARG1><,><ARG2><,><ARG3><,><ETX>

Where:
ARG1 = kV monitor = 0 – 4095
ARG2 = mA monitor = 0 – 4095
ARG3 = Filament monitor = 0– 4095

Example:
<STX><19>,4095,4095,4095,<ETX>

5.5.10 Request Total Hours High Voltage On

Description:
The host requests that the firmware sends the present value of the Total Hours High Voltage On.

Direction:
Host to supply

Syntax:
<STX><21><,><ETX>

Example:
<STX>21,<ETX>

Response:
<STX><21><,><ARG1>< ARG2>< ARG3><ARG4><ARG5>
<.><ARG6><,><ETX>

Where:
<.> = ASCII 0x2E
ARGx =0-9 in ASCII format

Example:
<STX>21,99999.9,<ETX>

5.5.11 Request Status

Description:
The host requests that the firmware sends the power supply status.

Direction:
Host to supply

Syntax:
<STX><22><,><ETX>

Example:
<STX>22,<ETX>

Response:
<STX><22><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,><,><ETX>

Where:
<ARG1> 1 = HvOn, 0 = HvOff
<ARG2> 1 = Interlock 1 Open, 0 = Interlock 1 Closed
<ARG3> 1 = Fault Condition, 0 = No Fault
<ARG4> 1 = Remote Mode, 0 = Local Mode

Example:
<STX>22,1,1,0,0,<ETX>

NOTE: This response will also be sent in an unsolicited manner when a change of state is detected on the HvOn and Interlock 1 bits. This is providing that a valid handle has already been established with a host.

5.5.12 Request DSP Software Part Number/Version

Description:
The host requests that the firmware sends the DSP firmware version.

Direction:
Host to supply

Syntax:
<STX><23><,><ETX>

Example:
<STX>23,<STX>

Response:
<STX><23><,>< ARG><,><ETX>

Where:
<ARG> consists of eleven ASCII characters representing the current firmware part number/version. The format is SWM9999-999

Example:
<STX>23,SWM9999-999,<ETX>

5.5.13 Request Hardware Version

Description:
The host requests that the firmware sends the hardware version.

Direction:
Host to supply

Syntax:
<STX><24><,><ETX>

Example:
<STX>24,<ETX>

Response:
<STX><24><,>< ARG><,><ETX>

Where:
<ARG> consists of 3 ASCII characters representing the hardware version.
The format is ANN, where A is an alpha character and N is a numeric
character

Example:
<STX>24,A01,<ETX>

5.5.14 Request Webserver Software Part Number/Version

Description:
The host requests that the firmware sends the Web Server firmware part number/version.

Direction:
Host to supply

Syntax:
<STX><25><,><ETX>

Example:
<STX>25,<ETX>

Response:
<STX><25><,><ARG><,><ETX>

Where:
<ARG> consists of eleven ASCII characters representing the current firmware part number/version. The format is SWM9999-999

Example:
<STX>25,SWM9999-999,<ETX>

5.5.15 Request Model Number

Description:
The host requests that the firmware sends the unit model number

Direction:
Host to supply

Syntax:
<STX><26><,><ETX>

Example:
<STX>26,<ETX>

Response:
<STX><26><,><ARG><,><ETX>

Where:
<ARG> consists of five ASCII characters representing the model number.
The format is XNNNN or DXBNN, where N is a numeric character. See
section 7.0 for model number codes.

Example:
<STX>25,X9999,<ETX>

5.5.16 Reset Run Hours

Description:
The host requests that the firmware resets the run hour counter.

Direction:
Host to supply

Syntax:
<STX><30><,><ETX>

Example:
<STX>30,<ETX>

Response:
<STX><30><,><$><,><ETX>

5.5.17 Reset Faults

<u>Description:</u>
The host requests that the firmware resets all Fault messages and indicators.

<u>Direction:</u>
Host to supply

<u>Syntax:</u>
<STX><31><,><ETX>

<u>Example:</u>
<STX>31,<ETX>

<u>Response:</u>
<STX><31><,><$><,><ETX>

5.5.18 Request Network Settings

Description:
The host requests that the firmware transmits the network settings

Application:

	ARG 1	ARG2	ARG3	ARG4	ARG5	ARG6
Function	Device Name	Remote Address	Remote Port	Subnet Mask	Default Gateway	MAC Address

rection:
Host to supply

Syntax:
<STX><50><,><ETX>

Example:
<STX>50,<ETX>

Response:
<STX><50><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,>
<ARG5><,><ARG6><,><ETX>

Arguments:
Device Name is limited to 20 characters or less. Remote address is a ip address in dotted notation. Remote port is a decimal number. Subnet Mask and Default Gateway are also dotted notation and MAC address is in MAC Address notation.

ARG1: Device Name   1 character minimum, up to 20 maximum
ARG2: IP Address   <nnn><.><nnn><.><nnn><.><nnn>, where
                         <nnn> represents a number from 0 to 255.
ARG3: Remote Port   5001 or from 49152 to 65535.
ARG4: Subnet Mask   <xxx><.><xxx><.><xxx><.><xxx>, where
                         <xxx> represents a number from 0 to 255.
ARG5: Default Gateway   <yyy><.><yyy><.><yyy><.><yyy>, where
                         <yyy> represents a number from 0 to 255.
ARG6: MACAddress   <zzz><:><zzz><:><zzz><:><zzz><:><zzz>
                         <:><zzz> , where <zzz> represents a number
                         from 0 to 255.

Example:
<STX>50,Spellman2.0,32.78.110.37,1026,255.0.0.0,192.168.1.1,0:100:3
3:1:32:84,<ETX>

5.5.19 Program Network Settings

Description:
The host requests that the firmware programs the network settings and then reboots.

Application:

	ARG 1	**ARG2**	**ARG3**	**ARG4**	**ARG5**	**ARG6**
Function	Device Name	Remote Address	Remote Port	Subnet Mask	Default Gateway	MAC Address

Direction:
Host to supply

Syntax:
<STX><51><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,>
<ARG5><,><ARG6><,><ETX>

Arguments:
Device Name is limited to 20 characters or less. Remote address is a ip address in dotted notation. Remote port is a decimal number. Subnet Mask and Default Gateway are also dotted notation and MAC address is in MAC Address notation.

ARG1: Device Name   1 character minimum, up to 20 maximum
ARG2: IP Address   <nnn><.><nnn><.><nnn><.><nnn>, where <nnn> represents a number from 0 to 255.
ARG3: Remote Port   5001 or from 49152 to 65535.
ARG4: Subnet Mask   <xxx><.><xxx><.><xxx><.><xxx>, where <xxx> represents a number from 0 to 255.
ARG5: Default Gateway   <yyy><.><yyy><.><yyy><.><yyy>, where <yyy> represents a number from 0 to 255.
ARG6: MACAddress   <zzz><:><zzz><:><zzz><:><zzz><:><zzz> <:><zzz> , where <zzz> represents a number from 0 to 255.

Example:
<STX>51,Spellman2.0,32.78.110.37,1026,255.0.0.0,192.168.1.1,0:100:3 3:1:32:84,<ETX>

Response:
None, as Embedded server reboots with new settings.

5.5.21   Read Interlock Status

<u>Description:</u>
The host requests that the firmware read the status of the interlock channel.

<u>Direction:</u>
Host to supply

<u>Syntax:</u>
<STX><55><,><ETX>

<u>Response:</u>
<STX><55><,><ARG1><,><ETX>
Where ARG1 is Interlocks 1. A 1 indicates that the Interlock is energized

<u>Example:</u>
<STX>55,1,<ETX>

5.5.21 Request kV Monitor

Description:
The host requests that the firmware report kV monitor.

Direction:
Host to supply

Syntax:
<STX><60><,><ETX>

Response:
<STX><60><,><ARG><,><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>60,4095,<ETX>

5.5.22 Request mA Monitor

Description:
The host requests that the firmware report mA monitor.

Direction:
Host to supply

Syntax:
<STX><61><,><ETX>

Response:
<STX><61><,><ARG><,><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>61,4095,<ETX>

5.5.23 Request Filament Feedback

Description:
The host requests that the firmware report Filament Feedback.

Direction:
Host to supply

Syntax:
<STX><62><,><ETX>

Response:
<STX><62><,><ARG><,><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>62,4095,<ETX>

5.5.24 Request –15V LVPS

Description:
The host requests that the firmware report –15V LVPS.

Direction:
Host to supply

Syntax:
<STX><65><,><ETX>

Response:
<STX><65><,><ARG><,><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>65,4095,<ETX>

5.5. 25 Request Faults

Description:
The host requests that the firmware report Faults.

Direction:
Host to supply

Syntax:
<STX><68><,><ETX>

Response:
<STX><68><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,><ARG5><,
><ARG6><,><ETX>

Where:
<ARGx> 1 = Fault, 0 = No Fault in ASCII format

ARG1 = ARC
ARG2 = Over Temperature
ARG3 = Over Voltage
ARG4 = Under Voltage
ARG5 = Over Current
ARG6 = Under Current

Example:
<STX>67,0,0,0,0,1,0,<ETX>

5.5.26 Turn HV on/off

Description:
The host requests that the firmware turn high voltage on or high voltage off.

Direction:
Host to supply

Syntax:
<STX><98><,><ARG><,><ETX>

Where:
<ARG> 1 = HV on, 0 = HV off in ASCII format

Example:
<STX>98,1,<ETX>

Response:
<STX><98><,><$><,><ETX>
<STX><98><,><ARG><,><ETX>

where <ARG> = error code

Error Codes TBD,
1 = out of range

5.5.27 Program Local/Remote Mode

Description:
The host requests that the firmware to switch between Local and Remote Mode.

Direction:
Host to supply

Syntax:
<STX><99><,><ARG><,><ETX>

Where:
<ARG> 1 = Remote, 0 = Local in ASCII format

Example:
<STX>99,1,<ETX>

Response:
<STX><99><,><$><,><ETX>
<STX><99><,><ARG><,><ETX>

where <ARG> = error code

Error Codes TBD,
1 = out of range

5.5.28 Program RS-232 Baud rate

Description:
The host requests that the firmware change the Baud rate for RS-232.

Direction:
Host to supply

Syntax:
<STX><07><,><ARG><,><CSUM><ETX>

Where:
<ARG> 1 = 9.6k in ASCII format
<ARG> 2 = 19.2k in ASCII format
<ARG> 3 = 38.4k in ASCII format
<ARG> 4 = 57.6k in ASCII format
<ARG> 5 = 15.2k in ASCII format

Example:
<STX>07,1,<CSUM><ETX>

Response:
<STX><07><,><$><,><CSUM><ETX>
<STX><07><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD,
1 = out of range

6.0 SERIAL COMMANDS – RS-232 / USB
6.1 SERIAL INTERFACE PROTOCOL

Serial communications will use the following protocol:

<STX><CMD><,>ARG><,><CSUM><ETX>

Where:
<STX>   = 1 ASCII 0x02 Start of Text character
<CMD>   = 2 ASCII characters representing the command ID
<,>   = 1 ASCII 0x2C character
<ARG>   = Command Argument
<,>   = 1 ASCII 0x2C character
<CSUM>   = Checksum (see section 6.3 for details)
<ETX>   = 1 ASCII 0x03 End of Text character

6.2 COMMAND ARGUMENTS

The format of the numbers is a variable length string. To represent the number 42, the string '42', '042', or '0042' can be used. This being the case, commands and responses that carry data are variable in length.

6.3 CHECKSUMS

The checksum is computed as follows:
- Add the <CMD>, <,>, and <ARG> bytes into a 16 bit (or larger) word. The bytes are added as unsigned integers.
- Take the 2's compliment (negate it).
- Truncate the result down to the eight least significant bits.
- Clear the most significant bit (bit 7) of the resultant byte, (bitwise AND with 0x7F).
- Set the next most significant bit (bit 6) of the resultant byte (bitwise OR with 0x40).

Using this method, the checksum is always a number between 0x40 and 0x7F. The checksum can never be confused with the <STX> or <ETX> control characters, since these have non-overlapping ASCII values.

If the DSP detects a checksum error, the received message is ignored – no acknowledge or data is sent back to the host. A timeout will act as an implied NACK.

The following is sample code, written in Visual Basic, for the generation of checksums:

```vb
Public Function ProcessOutputString(outputString As String) As String

Dim i As Integer
Dim CSb1 As Integer
Dim CSb2 As Integer
Dim CSb3 As Integer
Dim CSb$
Dim X

X = 0
For i = 1 To (Len(outputString))        'Starting with the CMD character
X = X + Asc(Mid(outputString, i, 1))    'adds ascii values together
Next i

CSb1 = 256 - X
CSb2 = 127 And (CSb1)        'Twos Complement
CSb3 = 64 Or (CSb2)         'OR 0x40
CSb$ = Chr(Val("&H" & (Hex(CSb3))))
ProcessOutputString = Chr(2) & outputString & CSb$ & Chr(3)

End Function
```

6.4 COMMAND OVERVIEW

Data Byte section of the TCP/IP Datagram			
Command Name	<CMD>	<ARG>	RANGE
Program RS-232 unit baud rate	07	1 ASCII	1 - 5
Program kV	10	1-4 ASCII	0-4095
Program mA	11	1-4 ASCII	0-4095
Program Filament Limit	12	1-4 ASCII	0-4095
Program Filament Pre-Heat	13	1-4 ASCII	0-4095
Request kV Setpoint	14	None	-
Request mA Setpoint	15	None	-
Request Filament Limit Setpoint	16	None	-
Request Filament Pre-Heat Setpoint	17	None	-
Request Analog Monitor Readbacks	19	None	-
			-
Request HV On Hours Counter	21	None	-
Request Status	22	None	-
Request Software Version	23	None	-
Request Hardware Version	24	None	-
Request Web Server Version	25	None	-
Request Model Number	26	None	-
Reset HV On Hours Counter	30	None	-
Reset Faults	31	None	-
Read Interlock Status	55	None	-
Request kV monitor	60	None	-
Request mA monitor	61	None	-
Request Filament Feedback	62	None	-

Request Filament Limit	63	None	-
Request Filament Pre-Heat	64	None	-
Request −15V LVPS	65	None	-
Turn HV on/off	98	1 ASCII	0 or 1
Program Local/Remote Mode	99	1 ASCII	0 or 1

6.5   RESPONSE OVERVIEW

The command responses will follow the same format as outlined above in section 6.1. This list is comprised of Commands with complex responses only. Commands using a simple response will use the <$> character (ASCII 0x24) as a "Success" response or a single character error code. These responses will be eight ASCII characters in length.

Response Name	<CMD>	Response
Request kV Setpoint	14	10 ASCII
Request mA Setpoint	15	10 ASCII
Request Filament Limit Setpoint	16	10 ASCII
Request Filament Pre-Heat Setpoint	17	10 ASCII
Request Analog Monitor Readbacks	19	23-50 ASCII
Request Total Hours High Voltage On	21	13 ASCII
Request Status	22	11 ASCII
Request DSP Software Version	23	17 ASCII
Request Hardware Version	24	9 ASCII
Request Web Server Version	25	17 ASCII

Request Model number	26	11 ASCII
Request Network Settings	50	48-104 ASCII
Read Interlock Status	55	11 ASCII
Request kV monitor	60	7-10 ASCII
Request mA monitor	61	7-10 ASCII
Request Filament Feedback	62	7-10 ASCII
Request –15V LVPS	65	7-10 ASCII
Request Faults	68	6 ASCII

6.6   COMMAND STRUCTURE

6.6.1   Program kV

Description:
The host requests that the firmware change the setpoint of kV.

Direction:
Host to supply

Syntax:
<STX><10><,><ARG><,><CSUM><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>10,4095,<CSUM><ETX>

Response:
<STX><10><,><$><,><CSUM><ETX>
<STX><10><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD, 1=out of range

6.6.2 Program mA

Description:
The host requests that the firmware change the setpoint of mA.

Direction:
Host to supply

Syntax:
<STX><11><,><ARG><,><CSUM><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>11,4095,<CSUM><ETX>

Response:
<STX><11><,><$><,><CSUM><ETX>
<STX><11><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD, 1=out of range

6.6.3 Program Filament Limit

Description:
The host requests that the firmware change the setpoint of Filament Limit.

Direction:
Host to supply

Syntax:
<STX><12><,><ARG><,><CSUM><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>12,4095,<CSUM><ETX>

Response:
<STX><12><,><$><,><CSUM><ETX>
<STX><12><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

Standard Scaling(0 – 4095 = 0 – 5 amps)

6.6.4 Program Filament Pre-Heat

Description:
The host requests that the firmware change the setpoint of Filament Pre-Heat.

Direction:
Host to supply

Syntax:
<STX><13><,><ARG><,><CSUM><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>13,4095,<CSUM><ETX>

Response:
<STX><13><,><$><,><CSUM><ETX>
<STX><13><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

Standard Scaling(0 – 4095 = 0 – 2.5 amps)

6.6.5 Request kV Setpoint

Description:
The host requests that the firmware report the kV setpoint.

Direction:
Host to supply

Syntax:
<STX><14><,><CSUM><ETX>

Response:
<STX><14><,><ARG><,><CSUM><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>14,4095,<CSUM><ETX>

6.6.6 Request mA Setpoint

Description:
The host requests that the firmware report the current mA setpoint.

Direction:
Host to supply

Syntax:
\<STX>\<15>\<,>\<CSUM>\<ETX>

Response:
\<STX>\<15>\<,>\<ARG>\<,>\<CSUM>\<ETX>

Where:
\<ARG> = 0 - 4095 in ASCII format

Example:
\<STX>15,4095,\<CSUM>\<ETX>

6.6.7   Request Filament Limit Setpoint

Description:
The host requests that the firmware report the current Filament Limit
setpoint.

Direction:
Host to supply

Syntax:
<STX><16><,><CSUM><ETX>

Response:
<STX><16><,><ARG><,><CSUM><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>16,4095,<CSUM><ETX>

6.6.8 Request Filament Pre-Heat Setpoint

Description:
The host requests that the firmware report the current Filament Pre-Heat setpoint.

Direction:
Host to supply

Syntax:
<STX><17><,><CSUM><ETX>

Response:
<STX><17><,><ARG><,><CSUM><ETX>

Where:
<ARG> = 0 - 4095 in ASCII format

Example:
<STX>17,4095,<CSUM><ETX>

6.6.9 Request Total Hours High Voltage On

Description:
The host requests that the firmware sends the present value of the Total Hours High Voltage On.

Direction:
Host to supply

Syntax:
<STX><21><,><CSUM><ETX>

Example:
<STX>21,<CSUM><ETX>

Response:
<STX><21><,><ARG1>< ARG2>< ARG3><ARG4><ARG5>
<.><ARG6><,><CSUM><ETX>

Where:
<.> = ASCII 0x2E
ARGx = 0 - 9 in ASCII format

Example:
<STX>21,99999.9,<CSUM><ETX>

6.6.10 Request Status

Description:
The host requests that the firmware sends the power supply status.

Direction:
Host to supply

Syntax:
<STX><22><,><CSUM><ETX>

Example:
<STX>22,<CSUM><ETX>

Response:
<STX><22><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,><CSUM><ETX>

Where:
<ARG1> 1 = HvOn, 0 = HvOff
<ARG2> 1 = Interlock 1 Open, 0 = Interlock 1 Closed
<ARG3> 1 = Fault Condition, 0 = No Fault
<ARG4> 1 = Remote Mode, 0 = Local Mode

Example:
<STX>22,1,1,0,0,<CSUM><ETX>

NOTE: This response will also be sent in an unsolicited manner when a change of state is detected on the HvOn and Interlock 1 bits.

6.6.11 Request DSP Software Part Number/Version

Description:
The host requests that the firmware sends the DSP firmware version.

Direction:
Host to supply

Syntax:
<STX><23><,><CSUM><ETX>

Example:
<STX>23,<CSUM><STX>

Response:
<STX><23><,>< ARG><,><CSUM><ETX>

Where:
<ARG> consists of eleven ASCII characters representing the current firmware part number/version. The format is SWM9999-999

Example:
<STX>23,SWM9999-999,<CSUM><ETX>

6.6.12 Request Hardware Version

Description:
The host requests that the firmware sends the hardware version.

Direction:
Host to supply

Syntax:
<STX><24><,><CSUM><ETX>

Example:
<STX>24,<CSUM><ETX>

Response:
<STX><24><,>< ARG><,><CSUM><ETX>

Where:
<ARG> consists of 3 ASCII characters representing the hardware version.
The format is ANN, where A is an alpha character and N is a numeric character

Example:
<STX>24,A01,<CSUM><ETX>

6.6.13 Request Webserver Software Part Number/Version

Description:
The host requests that the firmware sends the Web Server firmware part number/version.

Direction:
Host to supply

Syntax:
<STX><25><,><CSUM><ETX>

Example:
<STX>25,<CSUM><ETX>

Response:
<STX><25><,><ARG><,><CSUM><ETX>

Where:
<ARG> consists of eleven ASCII characters representing the current firmware part number/version. The format is SWM9999-999

Example:
<STX>25,SWM9999-999,<CSUM><ETX>

6.6.14 Request Model Number

Description:
The host requests that the firmware sends the unit model number

Direction:
Host to supply

Syntax:
<STX><26><,><CSUM><ETX>

Example:
<STX>26,<CSUM><ETX>

Response:
<STX><26><,><ARG><,><CSUM><ETX>

Where:
<ARG> consists of five ASCII characters representing the model number. The format is XNNNN or DXBNN, where N is a numeric character. See section 7.0 for model number codes.

Example:
<STX>25,X9999,<CSUM><ETX>

6.6.15 Reset Run Hours

Description:
The host requests that the firmware resets the run hour counter.

Direction:
Host to supply

Syntax:
<STX><30><,><CSUM><ETX>

Example:
<STX>30,<CSUM><ETX>

Response:
<STX><30><,><$><,><CSUM><ETX>

6.6.16 Reset Faults

Description:
The host requests that the firmware resets all Fault messages and indicators.

Direction:
Host to supply

Syntax:
\<STX>\<31>\<,>\<CSUM>\<ETX>

Example:
\<STX>31,\<CSUM>\<ETX>

Response:
\<STX>\<31>\<,>\<$>\<,>\<CSUM>\<ETX>

6.6.17 Read Interlock Status

Description:
The host requests that the firmware read the status of the interlock channel.

Direction:
Host to supply

Syntax:
<STX><55><,><CSUM><ETX>

Response:
<STX><55><,><ARG1><,><CSUM><ETX>
Where ARG1 is Interlocks 1. A 1 indicates that the Interlock is energized

Example:
<STX>55,1,<CSUM><ETX>

6.6.18 Request kV Monitor

Description:
The host requests that the firmware report kV monitor.

Direction:
Host to supply

Syntax:
<STX><60><,><CSUM><ETX>

Response:
<STX><60><,><ARG><,><CSUM><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>60,4095,<CSUM><ETX>

6.6.19 Request mA Monitor

Description:
The host requests that the firmware report mA monitor.

Direction:
Host to supply

Syntax:
<STX><61><,><CSUM><ETX>

Response:
<STX><61><,><ARG><,><CSUM><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>61,4095,<CSUM><ETX>

6.6.20 Request Filament Feedback

Description:
The host requests that the firmware report Filament Feedback.

Direction:
Host to supply

Syntax:
<STX><62><,><CSUM><ETX>

Response:
<STX><62><,><ARG><,><CSUM><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>62,4095, <CSUM><ETX>

6.6.21 Request –15V LVPS

Description:
The host requests that the firmware report –15V LVPS.

Direction:
Host to supply

Syntax:
<STX><65><,><CSUM><ETX>

Response:
<STX><65><,><ARG><,><CSUM><ETX>

Where:
<ARG>=0-4095 in ASCII format representing unscaled value.

Example:
<STX>65,4095,<CSUM><ETX>

6.6.22 Request Faults

Description:
The host requests that the firmware report Faults.

Direction:
Host to supply

Syntax:
<STX><68><,><CSUM><ETX>

Response:
<STX><68><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,><ARG5><,
><ARG6><,><CSUM><ETX>

Where:
<ARGx> 1 = Fault, 0 = No Fault in ASCII format

ARG1 = ARC
ARG2 = Over Temperature
ARG3 = Over Voltage
ARG4 = Under Voltage
ARG5 = Over Current
ARG6 = Under Current

Example:
<STX>67,0,0,0,0,1,0,<CSUM><ETX>

6.6.23 Program Local/Remote Mode

Description:
The host requests that the firmware to switch between Local and Remote Mode.

Direction:
Host to supply

Syntax:
<STX><99><,><ARG><,><CSUM><ETX>

Where:
<ARG> 1 = Remote, 0 = Local in ASCII format

Example:
<STX>99,1,<CSUM><ETX>

Response:
<STX><99><,><$><,><CSUM><ETX>
<STX><99><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD,
1 = out of range

6.6.24 Program RS-232 Baud rate

Description:
The host requests that the firmware change the Baud rate for RS-232.

Direction:
Host to supply

Syntax:
<STX><07><,><ARG><,><CSUM><ETX>

Where:
<ARG> 1 = 9.6k in ASCII format
<ARG> 2 = 19.2k in ASCII format
<ARG> 3 = 38.4k in ASCII format
<ARG> 4 = 57.6k in ASCII format
<ARG> 5 = 115.2k in ASCII format

Example:
<STX>07,1,<CSUM><ETX>

Response:
<STX><07><,><$><,><CSUM><ETX>
<STX><07><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD,
1 = out of range

6.7   SPELLMAN TEST COMMANDS

- Program Hardware Version (Hardware setup)
- Program Model number(Hardware setup)
- Set USB Mode (Program USB)
- Set USB Page Address (Program USB)
- Send USB Page Data (Program USB)
- Toggle Passthrough Mode (Diagnostics)
- Store A/D Calibration Value (Hardware setup)
- Request Miscellaneous Analog Readbacks

Contact Spellman High Voltage for details and the syntax of these commands.

6.8 SERIAL COMMAND HANDLING

6.8.1 Command Time Out

The host computer should set a serial time out at approximately 100mS. This allows the DSP to process the incoming message, and transmit a response. The DSP will initiate a reply to incoming messages in approximately 1-2mS, with a worst case of 5mS.

6.8.2 Buffer Flushing

The DSP will flush the incoming serial data buffer every time an STX is received. This provides a mechanism to clear the receive buffer of partial or corrupt messages.

6.8.3 Handshaking

The only handshaking implemented on the host interface, is built in to the implementation of this protocol. That is, the host must initiate all communications. If the supply receives a program command, an acknowledge message is sent back to the host via the "$" message. If the host does not receive an acknowledge within the time out window, the host should consider the message lost or the device off-line.

Similarly, if the supply receives a request command, the requested data is sent back to the host. If the host does not receive the requested data within the time out window, the host should consider the message lost or the device off-line.

This essentially uses the full-duplex channel in a half-duplex communication mode.

7.0 DXB Standard Firmware Model # Codes

Standard model#	Firmware Model Code
300W	
DXB40PN300	DXB01
DXB60PN300	DXB02
DXB80PN300	DXB03
DXB100PN300	DXB04
DXB120PN300	DXB05
DXB140PN300	DXB06
600W	
DXB40PN600	DXB07
DXB60PN600	DXB08
DXB80PN600	DXB09
DXB100PN600	DXB10
DXB120PN600	DXB11
DXB140PN600	DXB12
1200W	
DXB40PN1200	DXB25
DXB60PN1200	DXB26
DXB80PN1200	DXB27
DXB100PN1200	DXB28
DXB120PN1200	DXB29
DXB140PN1200	DXB30