CHRobotics

Hydra Power Supply Datasheet

Document rev. 1.0, created 9/10/2013

1. Introduction

Device Overview

The Hydra is a DC-DC converter with three software-configurable outputs. The outputs can be independently changed via a serial expansion port (TTL USART), a USB port , or even with an iPhone or Android device using an optional Bluetooth expansion board.

The Hydra utilizes a buck-boost switching topology, allowing each output to be above, below, or equal to the input. Supported input voltages range from 5.0V to 14.0V. Each output can be independently configured between 2.5V and 14.0V.

With its palm-sized aluminum case, the Hydra provides all the flexibility of a bench-top supply without using up your desk space. Unlike a bench-top supply, you can use the Hydra anywhere: it's small size and flexibility make it a perfect power solution, whether for a mobile robot or an industrial system.

The Hydra is packed with features, including reverse polarity protection, ESD and surge protection on all inputs and outputs, over-current protection, automatic thermal shutdown, and user-adjustable output current limits. When combined with the included PC software, the Hydra can function as a battery charger for lithium, NiMH, NiCD, and lead-acid batteries. And with 2.5A continuous current capability per output, the Hydra is equipped to meet virtually all project needs, including powering servos, cameras, wireless transmitters, and control electronics.

Summary of Features

- One input, three independent outputs
- Control via USB, serial, or Bluetooth 4.0 (iPhone or Android devices using optional Bluetooth expansion board)
- Adjustable output current limits
- Current control mode allows the Hydra to act as a current source (drives high power LEDs, etc.)
- CNC-machined, anodized aluminum enclosure
- Output short circuit protection
- Thermal shutdown
- ESD and surge protection on all inputs and outputs
- Reverse polarity protection on voltage input

Specifications

- Accepts input voltages from 5.0V to 14.0V
- Output voltages individually configurable from 2.5V to 14.0V
- Output voltage resolution: 0.01 volts
- Max continuous current per output: 2.5A at 5V (~12 watts available per output at any voltage level)
- Output voltage ripple: < 2.9mV RMS at 100mA, < 60mV RMS at 2.5A
- Buck-boost topology allows the input to be above, below, or equal to the outputs

Table of Contents

List of Tables

2. Revision History

Rev. 1.0 – 9/10/2013: Initial Release

3. Absolute Maximum Ratings

Table 1 - Absolute Maximum Ratings
Note: operating the Hydra at or above its maximum ratings can cause permanent damage to the device and is not recommended.

Symbol	Ratings	Maximum Value	Unit
Vdd	Supply voltage	-0.3 to +15.0V	V
Vin	Input voltage on expansion port UART pins (TX,RX)	-0.3 to +3.5V	V
Top	Operating temperature range	0 to +85	˚C
Tstg	Storage temperature range	-40 to +125	˚C

4. Electrical Characteristics

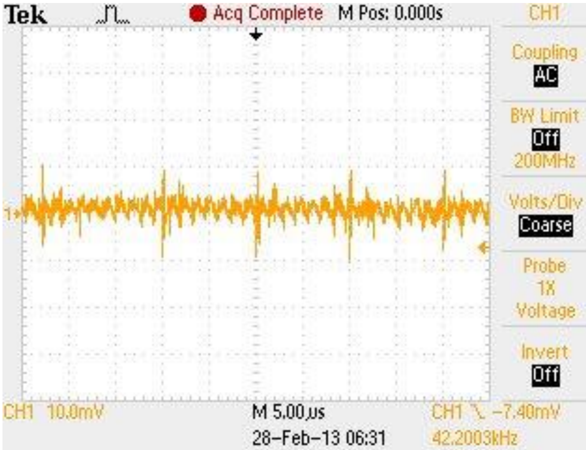
Table 2 - Electrical Characteristics

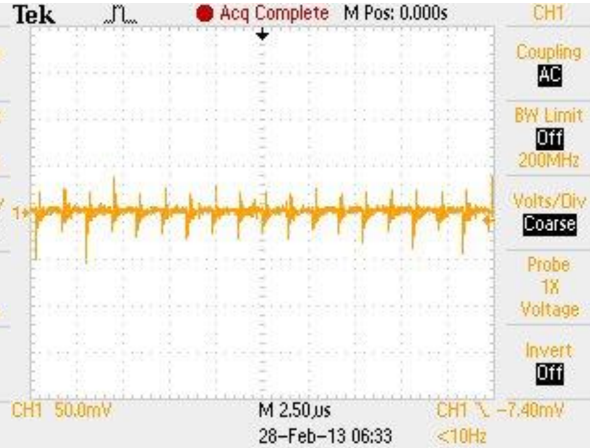
Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Vdd	Supply voltage		5	5.0-14.0	14.0	V
Vout1	Output voltage*		2.5	2.7 – 13.8	14.0	V
Vout2	Output voltage*		2.5	2.7 – 13.8	14.0	V
Vout3	Output voltage*		2.5	2.7 – 13.8	14.0	V
Imax	Max. output current	Vin >= 5V, Vout = 5V	2.5	-	-	A
Ipeak	Transient peak current limit	per output	7	10	12	A
Irev	Reverse current limit		-0.5	-1	-1.5	A
Tlim	Temperature at which current limiter engages		-	130	-	C
Toff	Temperature at which supply is disabled		-	155	-	C
Trestart	Temperature for restart after thermal shutoff		-	145	-	C
Fs	Switching frequency		675	750	825	kHz
Vr,rms	RMS voltage ripple	Iout = 100mA, Vin = 12V, Vout = 5V	-	3.9	-	mV
Vr,rms	RMS voltage ripple	Iout = 2100mA, Vin = 12V, Vout = 5V	-	22.7	-	mV
Vr,pk	pk-pk ripple	Iout = 100mA, Vin = 12V, Vout = 5V	-	20	-	mV
Vr,pk	pk-pk ripple	Iout = 2100mA, Vin = 12V, Vout = 5V	-	60	-	mV

******Maximum output voltage range is typical and not guaranteed.*

Typical switching noise at 100mA output (Vin = 12V, Vout = 5V)

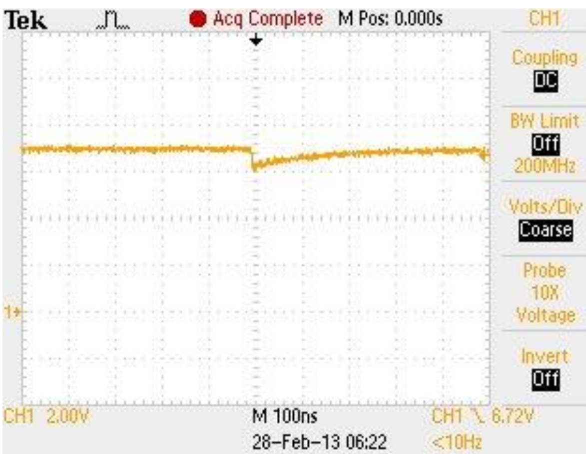
Typical switching noise at 2.1A output (Vin = 12V, Vout = 5V)

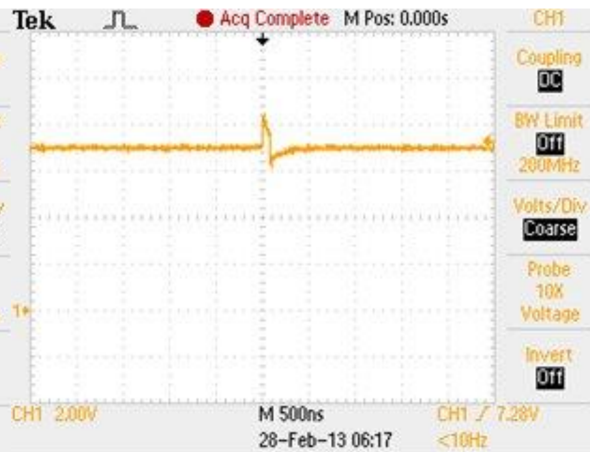




Output voltage response to 60mA to 2100mA current step (Vin = 12V, Vout = 5V)

Output voltage response to 2100mA to 60mA current step (Vin = 12V, Vout = 5V)





5. Pin Configuration and Functional Descriptions

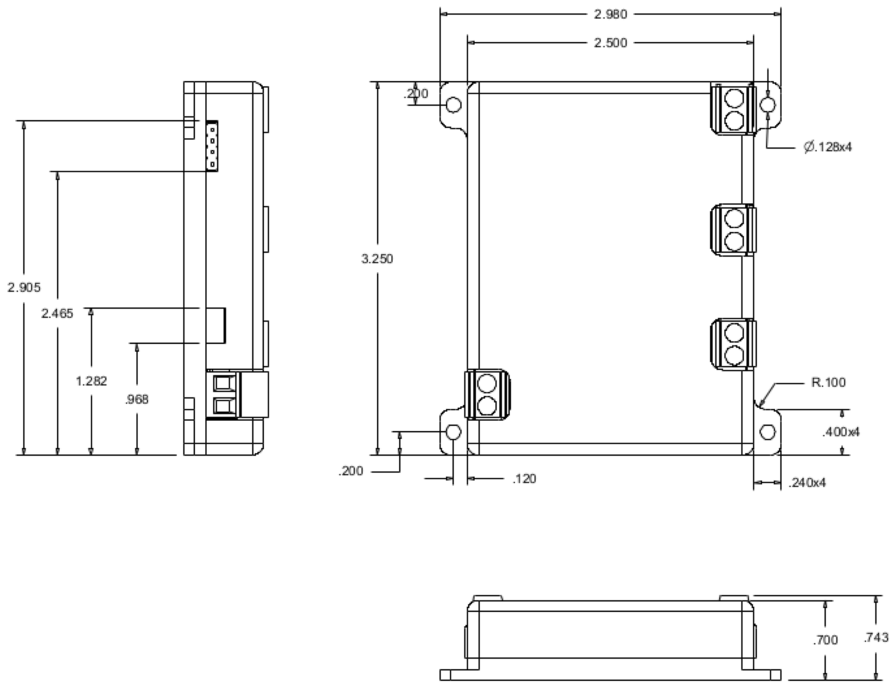
Table 3 - Pin Descriptions (expansion port)

Pin Description		
Pin #	Pin Name	Description
1*	GND	Ground
2	USART_RX	Hydra USART RX (in, 3.3V TTL)
3	USART_TX	Hydra USART TX (out, 3.3V TTL)
4	Vin	Hydra voltage input. Should not be used to power the Hydra, but can be used to power peripherals and expansion boards. This pin is connected internally to the Vin screw terminal.

**Pin 1 on the 4-pin expansion port is the pin closest to the corner of the Hydra*

6. Mechanical Drawings

Top and Side Views
(Dimensions are in inches)



7. Basic Operation

7.1. Powering and using the Hydra

The Hydra requires an input voltage (Vin) ranging from +5.0 V to +14.0V. Supply voltages outside this range are not supported. The voltage input on the Hydra is protected by a 400 watt TVS diode with a standoff voltage of +15V. This will protect the Hydra from ESD transients and from lengthy transients on poorly conditioned power buses, but prolonged exposure to voltages above 15 volts could damage the device.

Once powered, the Hydra can be configured via USB using either a serial terminal (like Putty for Windows or Minicom for Linux) or by using the included user interface PC software. Configuration using either method is straightforward, and specific details are given in additional app notes available through the CH Robotics website. For those interested in designing custom hardware and/or software to control the Hydra, more details are given in 8 - Communicating with the Hydra.

The Hydra communicates either in ASCII mode or in binary mode. In ASCII mode, the Hydra provides status information over the serial port in a human-readable ASCII table. The table includes information about input and output voltages, currents, current limits, and the status of each power supply output. In this mode, the Hydra can be configured by typing commands into a serial terminal. A list of commands is given in 8 - Communicating with the Hydra.

In binary mode, the Hydra packages information about the status of the power supply input, outputs, and settings into a compact, efficient data packet and transmits it twice per second. The binary protocol is not human-readable, meaning that if you were to connect to the Hydra using a serial terminal while it is in binary mode, the information printed to the screen wouldn't make sense. If computer software is used to read data, however, the binary protocol is easier to parse and interpret, it is more efficient, and it is less likely to suffer from communication bit errors. The packet protocol used by the Hydra in binary mode is described in 8.

When in ASCII mode, the Hydra can be switched to binary mode by sending the character sequence ":b" following by a carriage return. In binary mode, the Hydra can be switched back to ASCII mode by sending the character sequence ":x". No carriage return is required in this case.

The user interface software that comes with the Hydra automatically switches the Hydra to binary mode when connected.

7.2. Low voltage cutoff

The Hydra can be configured to automatically disable all of its outputs and transition to a low-power sleep mode if the input voltage drops below a user-defined threshold. This can be used to prevent the Hydra from over-discharging batteries. Once in sleep mode, the Hydra must be power-cycled to re-enabled the outputs even if the input voltage rises above the threshold again. While in sleep mode, the Hydra can still receive and respond to configuration commands from the user interface, a serial terminal, or any other device that communicates with the Hydra via its expansion port.

Each of the outputs on the Hydra can be configured to remain active even if the low voltage cutoff condition is active. This allows some outputs to be disabled on an undervoltage condition while others remain enabled.

Note that even when in low-power mode, the Hydra still consumes small amounts of current and WILL drain a battery over time even though the low voltage cutoff has been activated.

7.3. High efficiency, low current mode

Each output on the Hydra can be configured to operate in high-efficiency, low-current mode. In this mode, the maximum output current is limited (on the order of 100 mA max per output), but the efficiency of each output at low currents is increased significantly.

7.4. Current Control Mode

If the output current ever rises above the maximum limit set by the user, the Hydra will automatically modify its output voltage to drop the current to the programmed limit. It is important to note that this feature is a slowly-responding software feedback loop, and is not sufficient to prevent damage to circuits that require tight control of current and/or supply voltage. Highly nonlinear loads (like LEDs with no series resistor between the supply and the LED) may cause the Hydra to rapidly switch between voltage and current control modes.

8. Communicating with the Hydra

The best way to communicate with the Hydra is to use the downloadable PC software. This allows users to easily customize all output settings on the Hydra while simultaneously viewing the output voltages and current in real-time.

Alternatively, users can connect to the Hydra using a serial terminal, or using an external microcontroller.

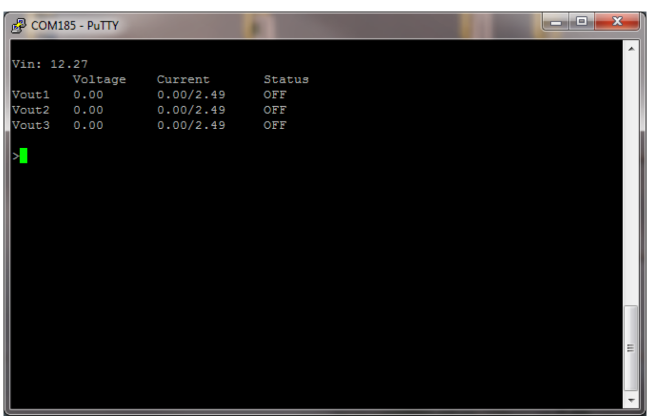
Communication with the Hydra is performed using a 3.3V TTL UART at 9600 baud* or a USB bus. In the case of the USB bus, an onboard USB-serial converter is used to convert the USB messages to serial messages to control the Hydra – the USB-serial converter shows up as a serial port when connected to the computer.

**While the Hydra now ships with a baud rate of 9600, some early models shipped with a baud rate of 14400. This non-standard baud rate is supported by Windows, but may not be supported on some Linux builds.*

8.1. ASCII Mode

When in ASCII mode (default), the Hydra displays data in human-readable ASCII characters and receives commands in the same way.

When connected to a serial port, typing a carriage return (the “Enter” key) causes the Hydra to display a table summarizing the output voltages, currents, and enabled/disabled state for each of the three outputs as shown below.



The “Status” column indicates whether the supply is turned on, and whether it is in voltage control or current control mode (OFF, CV, or CC).

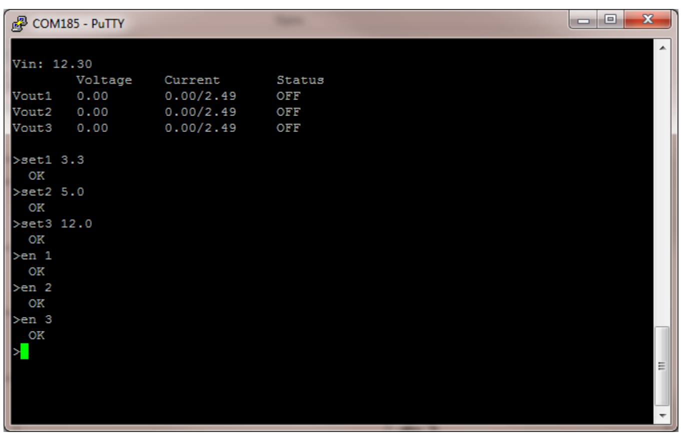
The “Current” column displays the output current per supply, in addition to the configured maximum current settings.

Finally, the “Voltage” column shows the voltages on the supply outputs. This will display the voltage on the power supply output even if the supply output is turned off.

A number of commands can be used to configure the Hydra from the serial terminal as shown below.

Command Syntax	Description	Example
set[n] [V]	Sets the target output voltage of supply n to voltage V in volts	set1 3.3 set2 5.0 set4 12.0
setc[n] [C]	Sets the maximum output current of supply n to C in amps	setc1 2.5 setc2 1.0 setc3 0.25
en [n]	Enables supply n	en 1 en 2 en 3
dis [n]	Disables supply n	dis 1 dis 2 dis 3
:b <CR>	Switches the Hydra to binary mode	:n [User presses “return”]
:x	Exits binary mode and returns to ASCII mode	:x

The input voltage cutoff threshold cannot currently be set using the serial terminal.



8.2. Binary Mode

The Hydra can be switched to binary mode by typing “:x <CR>” on the serial terminal. The <CR> represents a carriage return (the “return” key on the keyboard). When the PC software is connected to the Hydra, it automatically switches the Hydra to binary mode for efficient communication. When in binary mode, the Hydra will automatically transmit a packet containing status information twice per second.

Users will typically not need to explicitly work with the Hydra in binary mode. The PC software handles low-level communication wherever it is needed, and ASCII mode can be used to set most configuration settings from a serial terminal. The main exception is if users want to control the Hydra using custom software or with an external microcontroller. In that case, binary mode is the most efficient way to share data between the Hydra and the external processor.

In binary mode, data is retrieved from the Hydra by reading from onboard 32-bit registers. Configuration is similarly performed by writing data to the onboard 32-bit configuration registers. Commands can also be sent to the Hydra to perform specific functions.

Registers can be read and written individually or in "batch" operations. In a batch operation, more data is read/written at once to reduce communication overhead for large transfers. In a batch read, the packet address specifies the starting address of the read. For the remainder of the batch, the address of the register to be read increments by one until the batch length is reached. The behavior of a batch write is similar.

The length of the batch is specified in registers, NOT in bytes. For example, a batch length of 4 specifies that 16 bytes will be read/written in the batch (there are 4 bytes in each register, so a batch length of 4 registers results in 4*4 = 16 bytes).

8.2.1. Binary Serial Packet Structure

When communication is performed over the UART, data transmitted and received by the Hydra is formatted into packets containing:

1. The three character start sequence 's', 'n', 'p' to indicate the start of a new packet (i.e. **s**tart **n**ew **p**acket)
2. A "packet type" (PT) byte describing the function and length of the packet
3. An address byte indicating the address of the register or command
4. A sequence of data bytes, the length of which is specified in the PT byte
5. A two-byte checksum for error-detection

Table 4 - UART Serial Packet Structure

's'	'n'	'p'	packet type (PT)	Address	Data Bytes (D0...DN-1)	Checksum 1	Checksum 0

All packets sent and received by the Hydra must conform to the format given above.

The PT byte specifies whether the packet is a read or a write operation, whether it is a batch operation, and the length of the batch operation (when required). The PT byte is also used by the Hydra to respond to commands. The specific meaning of each bit in the PT byte is given below.

Table 5 - Packet Type (PT) byte

7	6	5	4	3	2	1	0
Has Data	Is Batch	BL3	BL2	BL1	BL0	RES	CF

Table 6 - Packet Type (PT) Bit Descriptions

Bit(s)	Description
7	Has Data: If the packet contains data, this bit is set (1). If not, this bit is cleared (0).
6	Is Batch: If the packet is a batch operation, this bit is set (1). If not, this bit is cleared (0)
5-2	Batch Length (BL): Four bits specifying the length of the batch operation. Unused if bit 7 is cleared. The maximum batch length is therefore 2^4 = 16
1	Reserved
0	Command Failed (CF): Used by the Hydra to report when a command has failed. Unused for packet sent to the Hydra.

The address byte specifies which register will be involved in the operation. During a read operation (Has Data = 0), the address specifies which register to read. During a write operation (Has Data = 1), the address specifies where to place the data contained in the data section of the packet. For a batch read/write operation, the address byte specifies the starting address of the operation.

The "Data Bytes" section of the packet contains data to be written to one or more registers. There is no byte in the packet that explicitly states how many bytes are in this section because it is possible to determine the number of data bytes that should be in the packet by evaluating the PT byte.

If the Has Data bit in the PT byte is cleared (Has Data = 0), then there are no data bytes in the packet and the Checksum immediately follows the address. If, on the other hand, the Has Data bit is set (Has Data = 1) then the number of bytes in the data section depends on the value of the Is Batch and Batch Length portions of the PT byte.

For a batch operation (Is Batch = 1), the length of the packet data section is equal to 4*(Batch Length). Note that the batch length refers to the number of registers in the batch, NOT the number of bytes. Registers are 4 bytes long.

For a non-batch operation (Is Batch = 0), the length of the data section is equal to 4 bytes (one register). The data section lengths and total packet lengths for different PT configurations are shown below.

Table 7 - Packet Length Summary

Has Data	Is Batch	Data Section Length (bytes)	Total Packet Length (bytes)
0	NA	0	7
1	0	4	11
1	1	4*(Batch Length)	7 + 4*(Batch Length)

Note that if a packet is a batch operation, the batch length must be greater than zero.

Read Operations
To initiate a serial read of one or more registers aboard the Hydra, a packet should be sent to the Hydra with the "Has Data" bit cleared. This tells the Hydra that this will be a read operation from the address specified in the packet's "Address" byte. If the "Is Batch" bit is set, then the packet will trigger a batch read in which the "Address" byte specifies the address of the first register to be read.

In response to a read packet, the Hydra will send a packet in which the "Has Data" bit is set, and the "Is Batch" and "Batch Length" bits are equivalent to those of the packet that triggered the read operation. The register data will be contained in the "Data Byte" section of the packet.

Write Operations
To initiate a serial write into one or more registers aboard the Hydra, a packet should be sent to the Hydra with the "Has Data" bit set. This tells the Hydra that the incoming packet contains data that should be written to the register specified by the packet's "Address" byte. If a batch write operation is to be performed, the "Is Batch" bit should be set, and the "Batch Length" bits should indicate the number of registers that are to be written to.

In response to a write packet, the Hydra will update the contents of the specified register(s) with the contents of the data section of the packet. The Hydra will then transmit a COMMAND_COMPLETE packet to indicate that the write operation succeeded. A COMMAND_COMPLETE packet is a packet with PT = 0 (no data, no batch) and with an address matching the address of the register to which the write operation was made, or the start address of the write operation if this was a batch write.

Note that the COMMAND_COMPLETE packet is equivalent to a packet that would cause the Hydra to initiate a read operation on the address to which data was just written. Since the packet is going from the Hydra to the host, however, its meaning is different (it would not make sense for the Hydra to request the contents of one of its registers from an external host).

Command Operations
There are a variety of register address that do not correspond with actual physical registers aboard the Hydra. These "command" addresses are used to cause the Hydra to execute specific commands (there are commands for executing calibration operations, resetting the onboard filters, etc. See the Hydra Register Overview in this document for more details).

To initiate a command, simply send a packet to the Hydra with the command's address in the packet "Address" byte. The PT byte should be set to zero for a command operation.

If the Hydra successfully completes the specified command, then a COMMAND_COMPLETE packet is returned with the command address in the "Address" byte of the response packet. If the command fails, the Hydra responds by sending a COMMAND_FAILED packet. The COMMAND_FAILED packet is equivalent to the COMMAND_COMPLETE packet except that the "Command Failed" bit in the PT byte is set (CF = 1).

In some cases, a command will cause specific packets to be sent other than the COMMAND_COMPLETE packet. A GET_FW_VERSION command will, for example, return a packet containing the version of the firmware installed on the power supply. In this and similar cases, the COMMAND_COMPLETE packet is not sent.

8.2.2. Binary Mode Examples

While in binary mode, the Hydra will automatically transmit a packet containing status information two times a second. This packet is a batch packet, containing data registers V1_STATUS, V2_STATUS, V3_STATUS, and VIN_STATUS. Details about the contents of each of these registers is given in Section 0 – Hydra Register Overview.

The hex contents of the packet are as shown below:

s	n	p	PT	Addr	Data	Checksum1	Checksum2
0x73	0x6E	0x70	0xD0	0x55	(4 registers * 4 bytes/register = 16 bytes)	High-order checksum	Low-order checksum

The Packet Type byte (PT) indicates that the packet has data, and that it is a batch packet containing 4 registers. In binary, these flags and settings work out to be 0b11010000.

The data section contains 16 bytes, or 4 bytes per register. The first register (the higher order 4 bytes in the data section) contains the register specified in the “Addr” byte in the packet, or (in this case) register 0x55. This address corresponds to the V1_STATUS register.

Assuming that the data bytes are stored in an array named data, code (in C) for extracting data from the V1_STATUS register might look something like this:

```c
// Pack the data bytes into one 32-bit value
uint32_t v1_status_reg = ((uint32_t)data[0] << 24) | ((uint32_t)data[1] << 16) |
                         ((uint32_t)data[2] << 8) | (uint32_t)data[3];

// Extract individual data items from the register
// Extract CV bit
uint8_t cv_mode = (v1_status_reg >> 31) | 0x01;

// Extract CC bit
uint8_t cc_mode = (v1_status_reg >> 30) | 0x01;

// Extract fault flag
uint8_t fault = (v1_status_reg >> 28) & 0x03;          // 2 bits used to indicate error types

// Extract current and convert to amps
uint16_t current = (v1_status_reg >> 16) & 0x0FFF;  // 12 bits used to store current
float fcurrent = (float)current/1000.0f;

// Extract the voltage and convert to volts
uint16_t voltage = v1_status_reg & 0x0FFFF;          // 16 bits used to store voltage
float fvoltage = (float)voltage/1000.0f;
```

The code for extracting settings for supplies 2 and 3 would look almost identical.

9. Hydra Register Overview

There are three types of registers onboard the Hydra: configuration registers, data registers, and command registers.

Configuration registers begin at address 0x00 and are used to configure Hydra operation. Configuration register contents are automatically written to onboard flash to allow settings to be maintained when the device is powered down.

Data registers begin at address 0x55, and store measured output voltages, currents, and statuses for each supply output.

Command registers technically aren't registers at all, but they provide a convenient way to send commands to the Hydra when those commands do not require additional data beyond the command itself. By using a unique register address for each command, the same communication architecture used to read from and write to data and configuration registers can be used to send commands to the Hydra. Command registers begin at address 0xAA.

9.1. Hydra Configuration Registers

Table 8 - Hydra Configuration Register Summary

Address	Register Name	Description
0x00	REG_V1_SETTINGS	Voltage and current settings for output 1
0x01	REG_V2_SETTINGS	Voltage and current settings for output 2
0x02	REG_V3_SETTINGS	Voltage and current settings for output 3
0x03	REG_VIN_SETTINGS	Input cutoff voltage settings
0x04	REG_V1_C1	Calibration coefficient for output voltage control
0x05	REG_V1_C2	Calibration coefficient for output voltage control
0x06	REG_V1_C3	Calibration coefficient for output voltage control
0x07	REG_V2_C1	Calibration coefficient for output voltage control
0x08	REG_V2_C2	Calibration coefficient for output voltage control
0x09	REG_V2_C3	Calibration coefficient for output voltage control
0x0A	REG_V3_C1	Calibration coefficient for output voltage control
0x0B	REG_V3_C2	Calibration coefficient for output voltage control
0x0C	REG_V3_C3	Calibration coefficient for output voltage control

9.1.1. REG_V1_SETTINGS (0x00)

Description

Specifies settings for output 1 on the Hydra.

Table 9 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
OE	LC	Res		max current in mA											

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
voltage target in mV															

Table 10 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	OE	When set, instructs the Hydra to enable the supply output
30	LC	When set, puts the Hydra into low current mode
28-29	Res	Reserved bits (unused)
16 – 27	current	These 12 bits store the maximum output current of the supply in mA
0 – 15	voltage	These 16 bits store the target output voltage of the supply in mV

9.1.2. REG_V2_SETTINGS (0x01)

Description

Specifies settings for output 2 on the Hydra.

Table 11 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
OE	LC	Res		max current in mA											

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
voltage target in mV															

Table 12 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	OE	When set, instructs the Hydra to enable the supply output
30	LC	When set, puts the Hydra into low current mode
28-29	Res	Reserved bits (unused)
16 – 27	current	These 12 bits store the maximum output current of the supply in mA
0 – 15	voltage	These 16 bits store the target output voltage of the supply in mV

9.1.3. REG_V3_SETTINGS (0x02)

Description

Specifies settings for output 3 on the Hydra.

Table 13 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
OE	LC	Res		max current in mA											

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
voltage target in mV															

Table 14 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	OE	When set, instructs the Hydra to enable the supply output
30	LC	When set, puts the Hydra into low current mode
28-29	Res	Reserved bits (unused)
16 – 27	current	These 12 bits store the maximum output current of the supply in mA
0 – 15	voltage	These 16 bits store the target output voltage of the supply in mV

9.1.4. REG_VIN_SETTINGS (0x03)

Description

Input voltage cutoff settings.

Table 15 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
D1	D2	D3	Reserved (Unused)												

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input voltage cutoff threshold in mV															

Table 16 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	D1	Voltage cutoff override. If set, leaves supply 1 turned on during voltage cutoff condition.
30	D2	Voltage cutoff override. If set, leaves supply 2 turned on during voltage cutoff condition.
29	D3	Voltage cutoff override. If set, leaves supply 3 turned on during voltage cutoff condition.
16 – 28	Reserved	Unused
0 – 15	cutoff	Sets the voltage threshold for input voltage cutoff

9.1.5. REG_V1_C1 – REG_V1_C3 (0x04 – 0x06)

Description

Calibration coefficients used internally to set target output voltages for output 1 on the Hydra. Each of the three registers stores a 32-bit IEEE floating point value. Calibration coefficients are set at the factory and should not be changed by the end user.

9.1.6. REG_V2_C1 – REG_V2_C3 (0x07 – 0x09)

Description

Calibration coefficients used internally to set target output voltages for output 3 on the Hydra. Each of the three registers stores a 32-bit IEEE floating point value. Calibration coefficients are set at the factory and should not be changed by the end user.

9.1.7. REG_V3_C1 – REG_V3_C3 (0x0A – 0x0C)

Description

Calibration coefficients used internally to set target output voltages for output 3 on the Hydra. Each of the three registers stores a 32-bit IEEE floating point value. Calibration coefficients are set at the factory and should not be changed by the end user.

9.2. Hydra Data Registers

9.2.1. Hydra Data Register Overview

Table 17 - Summary of Hydra Data Registers

Address	Register Name	Description
0x55	V1_STATUS	Status of supply 1
0x56	V2_STATUS	Status of supply 2
0x57	V3_STATUS	Status of supply 3
0x58	VIN_STATUS	Status of input voltage

9.2.2. V1_STATUS (0x55)

Description

Status register for supply 1.

Table 18 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
CV	CC	Fault		current in mA											

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
voltage in mV															

Table 19 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	CV	This bit is set when the Hydra is in CV (voltage control) mode.
30	CC	This bit is set when the Hydra is in CC (current control) mode.
16 – 27	current	These 12 bits store the measured output current of the supply in mA
0 – 15	voltage	These 16 bits store the measured output voltage of the supply in mV

9.2.3. V2_STATUS (0x56)

Description

Status register for supply 2.

Table 20 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
CV	CC	Fault		current in mA											

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
voltage in mV															

Table 21 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	CV	This bit is set when the Hydra is in CV (voltage control) mode.
30	CC	This bit is set when the Hydra is in CC (current control) mode.
16 – 27	current	These 12 bits store the measured output current of the supply in mA
0 – 15	voltage	These 16 bits store the measured output voltage of the supply in mV

9.2.4. V3_STATUS (0x57)

Description

Status register for supply 3.

Table 22 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
CV	CC	Fault		current in mA											

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
voltage in mV															

Table 23 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	CV	This bit is set when the Hydra is in CV (voltage control) mode.
30	CC	This bit is set when the Hydra is in CC (current control) mode.
16 – 27	current	These 12 bits store the measured output current of the supply in mA

0 – 15	voltage	These 16 bits store the measured output voltage of the supply in mV

9.2.5. VIN_STATUS (0x58)

Description

Status register for voltage input.

Table 24 - Register Definition

B3								B2							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
cutoff active	Reserved (unused)														

B1								B0							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
input voltage in mV															

Table 25 - Register Bit Definitions

BITS	NAME	DESCRIPTION
31	cutoff_active	This bit is set when the input voltage cutoff is active
16 – 30	reserved	These bits are unused
0 – 15	voltage	These 16 bits store the measured input voltage of the supply in mV

9.3. Hydra Command Registers

Command registers are technically not registers at all, but they provide a convenient way to trigger specific commands onboard the Hydra using the same communication interface used to write to and read from registers. Commands are initiated by executing a read command for the relevant command address using the UART.

Table 26 - Summary of Hydra Commands

Address	Packet Name	Description
0xAA	GET_FW_VERSION	Causes the Hydra to report the firmware revision.

9.3.1. GET_FW_VERSION (0xAA)

Causes the Hydra to report the firmware revision operating on the device. The firmware version is stored on the Hydra as a four-byte sequence of characters (ie. one register in length). For example, when the command is received over the UART, a packet containing the firmware revision is transmitted in response (the PT byte = 0, the Address byte = 0xAA, and the data section contains the firmware version).

Disclaimer

This document is provided as reference only; "typical" device specifications must be evaluated by the end-user. CH Robotics reserves the right to modify this document and the products it describes without notice.

CH Robotics products are not intended for use in weapons systems, aircraft, life-saving or life-sustaining systems, automobiles, or any other application where failure could result in injury, death, property damage, or environmental damage.