HotDrop™ Direct (Cloudless) Byte Map Guide

The HotDrop Direct

HotDrop™ is a wireless amperage meter that harvests flux power from the conductor it's clipped on using capacitors to store and manage the energy required for processing and transmissions. Energy accumulation, amperage, and min/max values of the current flowing through the conductor are edge processed on the HotDrop. HotDrop has no batteries and does not require maintenance. HotDrop Direct, the cloudless variant of HotDrop, reports data in a LoRaWAN-encrypted, single 11-byte packet transmitted wirelessly to a local LoRaWAN Gateway where the data is then unencrypted and sent to the client's LoRaWAN Network Server (LNS). It is the client's responsibility to maintain, store, correlate and analyze data exclusively on the client's systems. Note that as a locally managed solution, Vutility cannot see the data to provide troubleshooting assistance for HotDrop Direct.

Vutility uses the 11-byte packet and the LoRaWAN data rate 0 (DR0) to ensure the highest transmission deliverability, even when transmitting from within the metal enclosure of the electrical panel to the gateway. The optimized service deliverability and frequent, one-minute updates of key features are important for asset management and for monitoring current in industrial applications.

Data Packet Byte Map (11 bytes total)

This is a byte-map of the LoRaWAN Packet from HotDrop Direct. HotDrop Direct uses FPort 3 to send and receive payloads. Downlinks to HotDrop Direct also use FPort3. HotDrop Cloud sensors send packets on FPort 2 and have an additional encryption layer between the LNS and Vutility Cloud.

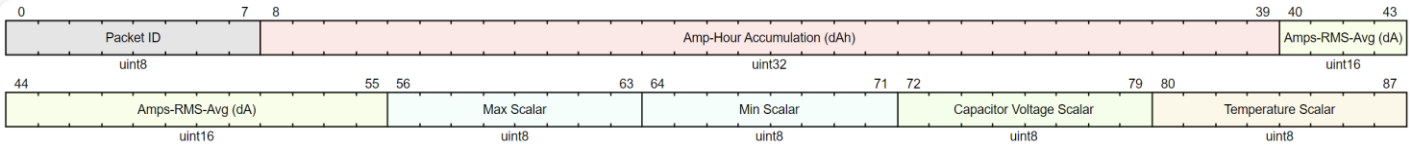

Chart: Packet #50 HotDrop Direct BYTE MAP

Packet ID (Byte #0)

Packet ID is an unsigned integer UINT8 (1 Byte) with a value equal to 50.

Amp-hour Accumulation (Byte #1-4)

HotDrop Direct transmits the latest amp_hour accumulation as an unsigned integer UINT32 (4 Bytes) in network byte order (MSB) reported as DeciAmpere Hour (dAh) units. It stores its cumulative Amp-Hour value with 100 mAh precision. The odometer for Amp-Hours could roll over (back to zero) in ~12 years (assuming a worst case 4,000 amps consumed 24x7x365).

FORMULA: Amp-Hours = deciAmp-hours/ 10 or Ahr = deciAmp-hours * 0.10

RMS_Amps (Bytes #5-6)

RMS-Amps are transmitted as an unsigned integer UINT16 (2 Bytes). HotDrop Direct samples the sinusoidal waveform each second at 3,300 samples-per-second, calculates the true RMS average rate of current over the last transmit period with 100 mA precision (10ths of Amps). NOTE: Lost amps packets can be cured by a simple calculation subtracting the previously transmitted Amp-Hours from the most recent arrival of the Amp-Hours and then dividing by the time interval.

FORMULA: Amps = deciAmps/ 10 or = deciAmps * 0.10

% Offset of max_Amps (Byte #7)

This value is an unsigned integer UINT8 (1 Byte) representing the percent (%) offset above the RMS Amps value. HotDrop Direct reports the maximum amperage seen any time since the last transmit. The precision of the readings is less than 1% error.

FORMULA: $$Amps_{Max}\,[dA] = Amps_{Avg}\,[dA] * \frac{100 + Max\ Offset}{100}$$

% Offset of min_Amps (Byte #8)

This value is an unsigned integer UINT8 (1 Byte) representing the percent (%) offset below the RMS Amps value. HotDrop Direct reports the minimum amperage seen since the last transmit. The precision of the readings is less than 1% error.

FORMULA: $$Amps_{Min}\,[dA] = Amps_{Avg}\,[dA] * \frac{100 - Min\ Offset}{100}$$

Capacitor Voltage Scalar (Byte #9)

Voltage is an unsigned integer UINT8 (1 Byte) representing the DC capacitor voltage akin to a battery indicator (where the integer from 0-255 is scaled to between 0.0V and 5.0V DC). If the circuit monitored by the HotDrop Direct, does not exceed 1.2 Amps, then there is not enough flux energy harvest and sustain minute-by-minute transmits and HotDrop Direct will enter low power mode (at the configured threshold) – this is designed to protect Client data. The customer can restore a predictable schedule by lengthening data transmissions to a longer interval, like 15 or 30 minutes (using OTA downlinks).

FORMULA: $$Capacitor\ Voltage\ [V] = \frac{5.0\ [V]}{255} * (Capacitor\ Voltage\ Scalar)$$

Temperature Scalar (Byte #10)

This value is an unsigned integer UINT8 (1 Bytes) representing the temperature— and the integer range from 0-255 is scaled to between -40C and 80C which are the operating temperature ranges for HotDrop Direct. This temperature can be correlated to the internal temperature of an enclosure.

FORMULA: $$Temperature\ [^oC] = \frac{120\ [^oC]}{255} * (Temperature\ Scalar) - 40\ [^oC]$$

HotDrop Direct Over the Air (OTA) configuration downlink payloads:

The following are supported & tested downlinks for HotDrop Direct (FPort3) Note: **default configurations are in red**.

Command	Description	Raw Packet	Base64 Encoding
Factory Reset	Returns accumulators back to 0 value	[46, 00, 00, 00, 00, 00, 00, 00, 00, 00]	RgAAAAAAAAAAAA==
Soft Reset	Doesn't reset accumulation on powercycle	[5A, 00, 00, 00, 00, 00, 00, 00, 00, 00]	WgAAAAAAAAAAAA==
Tx	1	[54, 00, 00, 00, 70, 42, 00, 00, 00, 00]	VAAAAHBCAAAAAA==
Transmit	2	[54, 00, 00, 00, F0, 42, 00, 00, 00, 00]	VAAAAPBCAAAAAA==
Interval*	5	[54, 00, 00, 00, 96, 43, 00, 00, 00, 00]	VAAAAJZDAAAAAA==
(mins)	15	[54, 00, 00, 00, 61, 44, 00, 00, 00, 00]	VAAAAGFEAAAAAA==
* payloads do not match encrypted HD, as "0" variance is set	30	[54, 00, 00, 00, E1, 44, 00, 00, 00, 00]	VAAAAOFEAAAAAA==

Installing:

HotDrop Direct is onboarded as a LoRaWAN device to an LNS either by pre-charging or clipping the HotDrop to a hot conductor (not a neutral). While attached over a hot conductor, the HotDrop will sustain 1-minute-transmissions, *by self-charging* if enough current is flowing through the conductor. HotDrop's LED will blink OFF and ON for charging in Low-Power-mode, or 3 times indicating a join process has begun. The LED will flash two times when joined to the LNS. HotDrop can be pre-charged by attaching a MicroUSB (5V maximum) source to prove the connection to an LNS. It is best practice to wait until you have confirmed the HotDrop has joined the LoRaWAN network (*and blinking 2 blinks*) before closing the electrical panel where the device is installed to avoid wasted time.

Additional Information

AppKey: 578AEE2D8FC7999FECD3DFFD25F66A0F
AppEUI: 00800000A0000767

Codec - GitHub - the-real-vutility/payload-codecs

LoRaWAN Version 1.0.2
LoRaWAN Regional Version 1.0.2B

Troubleshooting

- Make sure that there is ***enough current flowing in the conductor***. The 300A HotDrop requires ~2A to join the LNS and ~1 A to continue communicating.
- Make sure that the ***RSSI of the HotDrop is greater than -120***. Lower values indicate trouble communicating between the HotDrop and the gateway.
- For cellular backhaul, make sure that the signal is strong enough. Note that bars on a phone do not always give a true indicator of the cell signal.