

## Power Availability

Power availability is becoming an increasingly important topic in today's electronic world. As the use of electronic equipment increases in industry and the home, the degree of tolerance for power outages has decreased. In many cases, a very short loss or reduction of supply voltage can have a large economic impact.

The ION 8400™, ION 8500™ as well as the 9500™ and 9600™ meters come pre-configured with a power availability framework that provides reliability measurements using “number of nines” calculations.

### NOTE

While the Availability Framework is pre-configured, the operation of this framework requires the correct configuration of the Sag/Swell module according to your meter's power supply and operating ranges. See “Sag/Swell Module Configuration” on page 4. See also the *ION Programmer's Reference* for detailed descriptions of this module.

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### Additional Information

- ◆ Your meter's technical documentation
- ◆ ION Programmer's Reference

# Introduction

Power availability predicts, based on historical data, the probability that a specific power system will be functioning in its correct state at some point in the future. The availability calculation measures the time that power was available at the meter's monitoring point. This value can be used alone or incorporated with other reliability calculations.

Typically, a utility distribution system provides an availability of approximately 99.9%. Many applications require better availability than this: up to 99.9999% or better. At this level, the number of consecutive nines becomes difficult to determine at a glance. High levels of availability are commonly referred to as "Number of Nines": 99.9% corresponds to 3 nines; 99.9999% is 6 nines.

Once the meter is installed, the availability calculations must be reset to ensure valid time counts. You can reset availability calculations using ACCESS<sup>®</sup> software. In the case of 9500 and 9600 meters, availability can be reset via the meter's front panel. You can also pause availability calculations for meter maintenance or decommissioning purposes (refer to "Resetting and Pausing Power Availability" on page 5).

## Availability Framework - Release History (ION 8400, ION 8500)

| Firmware Versions | Release Dates             | Availability Features   | Comments  |
|-------------------|---------------------------|---|---|
| V209 - V231       | November, 00 to March, 03 | <ul style="list-style-type: none"> <li>◆ Arithmetic modules compare the last-stored time before the meter went down with the time the meter regained power.</li> <li>◆ Uptime calculates using a seconds counter and the down-time is added to provide the total uptime.</li> <li>◆ Disturbance time taken from the Sag/Swell module and downtime is added separately.</li> <li>◆ 'Include meter downtime' allows users to ignore planned outages.</li> </ul> | Availability implementation requires no user setup - if the meter loses power this is reflected in the Availability calculation.* |
| V240              | July, 03                  | <ul style="list-style-type: none"> <li>◆ Sag/Swell module in ION 8000 Series meter modified to record an outage when the blade-powered meter is unpowered.</li> <li>◆ Diagnostics module records meter outage duration.</li> </ul>  | Availability implementation requires no user setup.*  |

\* Requires proper configuration of the Sag/swell module to record system disturbances.

## Availability Framework - Release History (9500, 9600)

| Firmware Versions | Release Dates              | Availability Features  | Comments   |
|-------------------|----------------------------|--|--|
| V206 - V236       | Jan. 12, 2001 to Feb. 2003 | <ul style="list-style-type: none"> <li>◆ Sag/Swell Events on V4</li> <li>◆ Number of Nines display screen</li> </ul> | Availability implementation requires no user setup.* |

\* Requires proper configuration of the Sag/swell module to record system disturbances.

# Availability on the Meter Front Panel

The following power availability values display on the meter's front panel, and are viewable in the Vista™ component of WinPM.Net™ or ION Setup™ software:

- ◆ **Number of Nines:** the number of consecutive nines that appear in the most-significant digits of the availability value (e.g. "10" on the front panel indicates 10 nines: 99.99999999).
- ◆ **Availability-ppm:** the fraction of time that the power is available, in parts per million (ppm).
- ◆ **Evaluation Time (days):** the number of days that have elapsed since the calculation was last reset. This gives an indication of the time interval over which the availability calculation is made.
- ◆ The availability framework is found at this location within Designer: Advanced Setup\Power Quality Framework\Power Availability Framework.

## Sample Availability Framework Behaviors (ION 8400, ION 8500)

### Scenario 1: blade powered meter + power system outage

The Sag/Swell total disturbance time includes the outage. The meter downtime from the diagnostics module is added to the meter uptime to account for the total time of observation.

### Scenario 2: blade powered meter + meter decommissioned

The Sag/Swell module logs the downtime as disturbance time. When the meter powers back up, the meter downtime from the diagnostics module is added to the meter uptime.

### Scenario 3: auxiliary powered meter + power system outage

The Sag/Swell total disturbance time includes the outage. The meter never loses power, which means that there is no meter downtime and the meter uptime is equivalent to the total time of observation.

### Scenario 4: auxiliary powered meter + meter decommissioned

The Sag/Swell module does not log a disturbance time. When the meter powers back up, the meter downtime from the diagnostics module is added to the meter uptime.

## Assumptions

The above scenarios assume that:

1. The auxiliary powered meter assumed the power system was within specs during a meter down time if it didn't detect a disturbance prior to powering down.
2. The Sag/Swell module is configured correctly to monitor voltage disturbances.
3. The Sag limit is set above the voltage level at which the meter starts powering down.

- An auxiliary powered meter is used for applications that require a highly accurate measurement of power system downtime.

## Sag/Swell Module Configuration

Your meter's power availability framework requires that the Sag/Swell module be configured to the limits of your meter's power supply specification. See the online *ION Programmer's Reference* for detailed information on the operation of the Sag/Swell module.

Operating ranges of the ION 8000 Series meter are listed below:

| Power Supply                |                   | Operating Range                            |  |   |
|-----------------------------|-------------------|--|--|---|
|                             |                   | 9S   | 36S  | 35S                                     |
| 3-Phase blade powered meter | Option E          | (120 – 277) ± 15%<br>(102 – 318.5) VLN rms | (120 – 277) ± 15%<br>(102 – 318.5) VLN rms | 120 – 480 ± 15%<br>(102V – 552) VLL rms |
|                             | Option G          | 57.7 – 70VLN ± 15%<br>(49 – 80.5) VLN rms  | 57 – 70VLN ± 15%<br>(49 – 80.5) VLN rms    | N/A                                     |
| Auxiliary powered meter     | Option H (High V) | (160 – 277) ± 20% (128 – 332.4) VLN rms    |  |   |
|                             | Option J (Low V)  | 65 – 120 ± 20% (52 – 144) VLN rms          |  |   |

Operating ranges of the 9500 and 9600 are:

| Power Supply           | Operating Range   |
|------------------------|---|
| <b>9500 (Standard)</b> | 85-240 VAC, ±10%<br>47-63 Hz<br>110-330 VDC, ±10%<br>347 V L-N RMS /600 V L-L RMS |
| <b>9600 (Standard)</b> | 85-240 VAC, ±10%<br>47-63 Hz<br>110-330 VDC, ±10%<br>347 V L-N RMS /600 V L-L RMS |

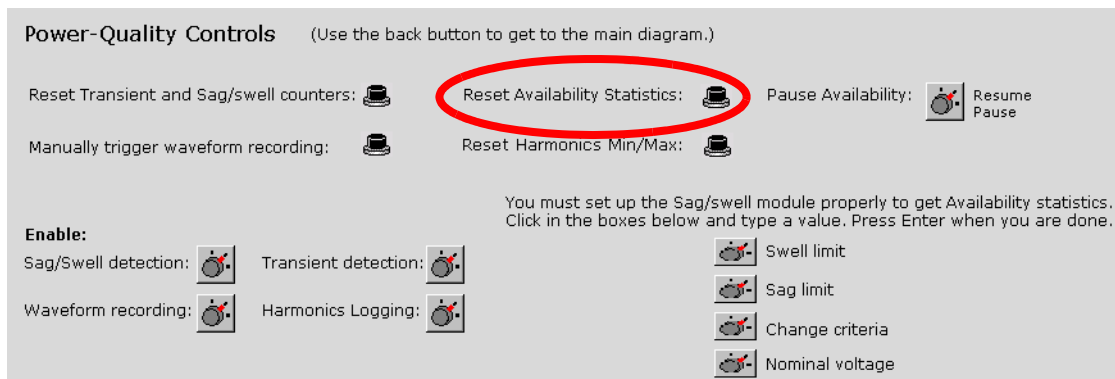
The ANSI C84.1 1989 standard recommends a Swell limit of 106% for Range B voltage levels, as well as a Sag limit of 88% for load voltages and 92% for the service entrance.

# Resetting and Pausing Power Availability

The power availability framework in the ION 8400, ION 8500, 9500 and 9600 allows the user to pause or reset its operation. The framework can be paused with ACCESS software; resetting the framework can be performed via ACCESS software or, in the case of the 9500 and 9600 meters, via the front panel settings.

## Resetting Availability with Vista

With Vista software, you can manually reset availability calculations. A meter is typically reset after installation to ensure valid time counts.



Availability calculations are reset with the *Rst Avlty Stats* (Reset Availability Statistics) External Pulse module, which can be accessed through the meter's front panel or with Vista software.

To ensure correct availability calculations, do not reset during a Sag or Swell.

### NOTE

The "Rst Avlty Stats" module exists in the 9500 / 9600 meter firmware v206 or later, or the ION 8000 Series meter firmware v209 or later.

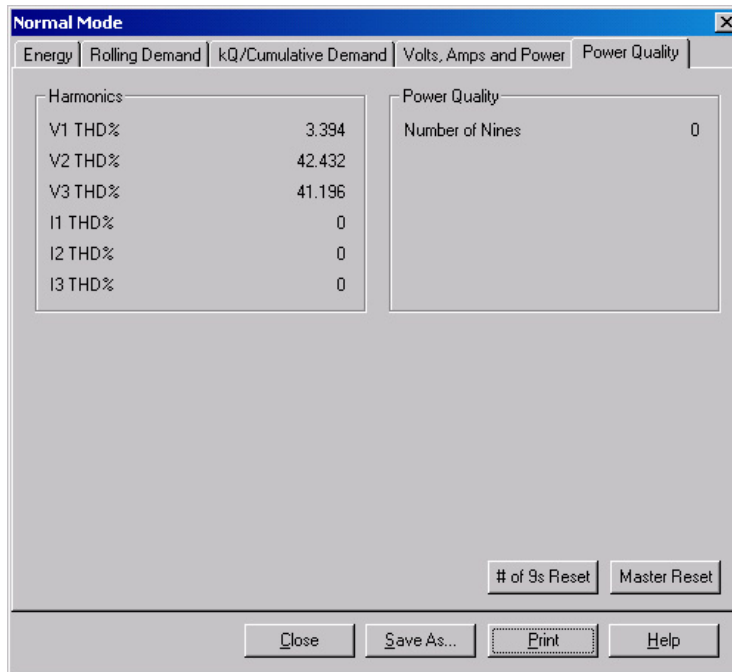
## Resetting Availability with ION Setup Software

### 9500, 9600, ION 8400, ION 8500

With ION Setup software, you can reset availability calculations by clicking on the button labeled "# of 9s Reset" in the Verification > Normal Mode > Power Quality tab.

1. Launch ION Setup software and double-click the Setup Assistant.
2. Click on the Verification setup screen, and from that screen, double-click Normal Mode.
3. In the Normal Mode screen, click the Power Quality tab.

4. In the Power Quality screen, click the button labeled “# of 9s Reset” to reset availability calculations. Provide a password (if requested), and click OK.



## Resetting Availability through the Meter Front Panel

### (9500 / 9600 meters only)

Through the meter's front panel, you can easily reset availability calculations.

1. Access the Setup screen on your meter's front panel.
2. Scroll to the Meter Resets setting and select it.
3. Select User Resets.
4. Select Availability Reset. The Enter Password window appears.
5. Enter your password.
6. Select Confirm. A window with “Reset Successful” appears. Also, on the User Resets screen, the word “Pulsed” appears beside the Availability Reset setting.



# Detailed Behavior

The Availability framework measures Disturbance time from the Sag/Swell module, Uptime from a counter module and meter Downtime from the Diagnostics module. Meter Downtime is added to the Uptime count to provide the total time of observation.

The meter uses three measurements when calculating the availability:

1. **Meter Uptime:** the time the meter is powered and actively monitoring. The time is measured by counting 1-second pulses from a periodic timer module.
2. **Meter Downtime:** this time is measured by the meter's internal clock and made available through the diagnostics module. The diagnostics module downtime register is updated on each power up. This calculation is accurate across a single month boundary: any additional month boundaries are assumed to have 30 days. You must set the Sag limit above the minimum voltage level specific to the power supply and wiring configuration of the meter (see "Sag/Swell Module Configuration" on page 4 for specifications). If there is no control power then it is assumed there is no power anywhere, and this time counts against availability.

When the meter powers up, it takes about 15 seconds before the ION modules are operational again. This power up time counts against the availability (a single power up per year limits total availability to 6 nines). If the application requires better resolution than this, then a UPS or other auxiliary power supply for the meter should be considered.

If the meter or control power circuit is taken out of service for maintenance, you can disable the measurement of meter downtime with ACCESS software; see "Pausing Availability" on page 7.

| Number of Nines | ppm (% x 10,000) | Downtime (seconds/year) | Downtime per year |
|-----------------|------------------|-------------------------|-------------------|
| 1               | 90%              | 3153600                 | 36.5 days         |
| 2               | 99%              | 315360                  | 3.7 days          |
| 3               | 99.9%            | 31536                   | 8.8 hours         |
| 4               | 99.99%           | 3153.6                  | 52.6 minutes      |
| 5               | 99.999%          | 315.36                  | 5.3 minutes       |
| 6               | 99.9999%         | 31.536                  | 31.5 seconds      |
| 7               | 99.99999%        | 3.153599998             | 3.2 seconds       |
| 8               | 99.999999%       | .3153599998             | .32 seconds       |
| 9               | 99.9999999%      | .03153599998            | .032 seconds      |
| 10              | 99.99999999%     | .003153599998           | .0032 seconds     |



3. **Voltage Disturbance Duration:** the total number of seconds that the voltage was outside the envelope determined by the Sag/Swell module. If several sags or swells occur during one second, only the last one counts toward the total. The Sag/Swell module settings may be used to control the voltage tolerance. If the Sag/Swell module is not enabled, no voltage disturbances are counted.

## Terminology

- ◆ **Blade-powered meter:** the power to run the meter is derived from the Voltage input terminals that are connected to the monitored system. The meter loses power if the monitored system is down. Specific to ION 8000 Series only.
- ◆ **Auxiliary-powered meter:** The power to run the meter is derived from an independent power source. The meter remains powered when the monitored system is down Specific to ION 8000 Series only.
- ◆ **Meter uptime:** the time the meter is powered and actively monitoring. The time is measured by counting 1-second pulses from a periodic timer module.
- ◆ **Meter downtime:** the time the meter is not powered. This time is measured by the meter's internal clock and made available through the diagnostics module. The diagnostics module downtime register is reset at the beginning of each outage.
- ◆ **Availability:** the probability of finding a system in the operating state at some time into the future. Availability is calculated as:

$$\begin{aligned} \text{Availability} &= \frac{\text{Time the power system is operating within specifications}}{\text{Total time of operation}^*} \\ &= \frac{\text{Meter uptime} - \text{disturbance time}}{\text{Meter uptime} + \text{meter downtime}} \end{aligned}$$

\* Where total time of observation = uptime + meter downtime

- ◆ **Unavailability:** calculated in the framework and then converted to number of nines, and Availability in percent and parts per million (ppm):

$$\begin{aligned} \text{Unavailability} &= \frac{\text{Time the power system is operating outside specifications}}{\text{Total time of operation}^*} \\ &= \frac{\text{Disturbance time}}{\text{Meter uptime} + \text{meter downtime}} \end{aligned}$$

\* Where total time of observation = uptime + meter downtime