

Understanding LED indications

The LED indicator between the N and S terminals provides an indication of the MTU/MTU-A status.



Fig. 2-16: Instrument LED indicator.

Original indication sequence

On instruments with firmware prior to 3112F, for most indications, the LED blinks in a specific pattern that repeats every 12s.

System startup.

- During system startup, the LED blinks once, then lights steadily for about 30s.

Initial satellite lock. To synchronize with UTC and begin data acquisition or calibration, the MTU/MTU-A must receive signals from at least four GPS satellites. Under normal conditions, this takes less than 10min. A longer delay may indicate poor antenna positioning or a faulty antenna or cable.

- Before acquisition, the LED pattern is 1s on, 1s off, for each satellite acquired, for up to four satellites.

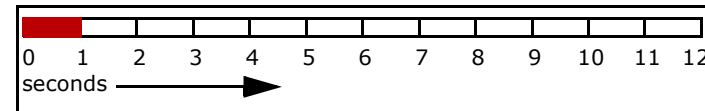


Fig. 2-17: Before data acquisition, one satellite acquired.

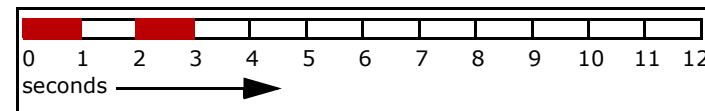


Fig. 2-18: Before data acquisition, two satellites acquired.

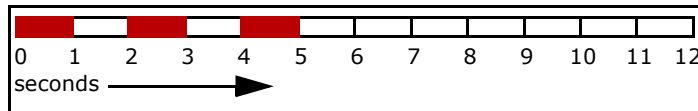


Fig. 2-19: Before data acquisition, three satellites acquired.

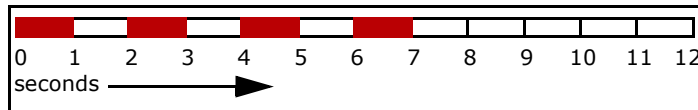


Fig. 2-20: Before data acquisition, satellite lock achieved (four or more satellites acquired).

During data acquisition. The MTU/MTU-A can acquire site or calibration data any time after the initial four-satellite lock has been achieved. It is not necessary for satellite lock to continue uninterrupted, because the MTU/MTU-A internal clock stays synchronized with UTC for several hours even if satellite lock is temporarily lost.

- During data acquisition, the LED blinks in a pattern of one second on, two seconds off, for each satellite acquired, to a maximum of four satellites.

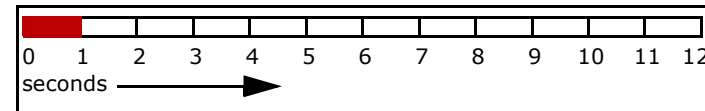


Fig. 2-21: During data acquisition, one satellite acquired.

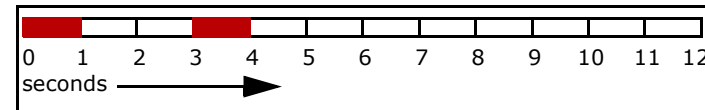


Fig. 2-22: During data acquisition, two satellites acquired.

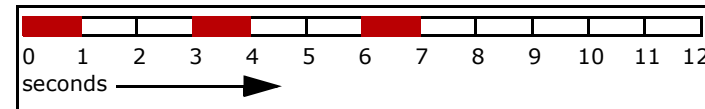


Fig. 2-23: During data acquisition, three satellites acquired.

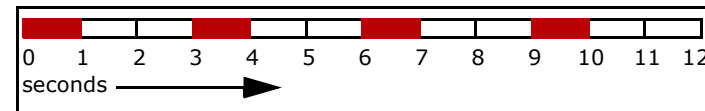



Fig. 2-24: During data acquisition, four or more satellites acquired.

Tip If a PC is connected to the MTU/MTU-A and the WinHost program is running, you can learn the exact number of acquired satellites by clicking  and examining the **GPS Status** pane in the **Information Parameters** dialog. The number may vary from 0 to 8.

After data acquisition. The MTU/MTU-A can be programmed to continue operating at idle or to shut down at the end of site data acquisition. It will idle after calibration data acquisition.

- If the MTU/MTU-A shuts down, the LED will go out.
- If the MTU/MTU-A is idling, the LED will blink in a pattern of one second on, 5 seconds off.

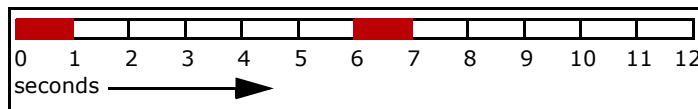


Fig. 2-25: Idling after site or calibration data acquisition.

New indication sequence

Beginning with firmware version 3112F, for most indications the LED flashes in a sequence that repeats

every 15s. Seven seconds are used to indicate the status of the instrument, including warning and error messages. Two seconds are used to indicate the status of satellite lock. The satellite indication is aligned with UTC seconds :00, :15, :30, and :45. Two seconds are used to indicate the status of the on-board clock, and four seconds are used to indicate the instrument mode.

System startup and shutdown.

- During system startup, the LED flashes once, then again, then lights steadily for about 30s. This pattern is the same as in previous firmware versions.
- During system shutdown, the LED lights steadily until shutdown is complete. Do not disconnect battery power until the LED goes out.

Instrument status. Seven seconds of the sequence are used to indicate either that the instrument is performing normally or that there is an error or a potential error, such as overheating or low battery voltage.

- If the instrument is performing normally, the LED is off for one second, then lights steadily for 5 seconds, then goes off for one second.

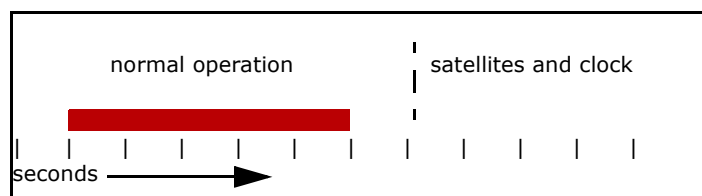


Fig. 2-26: Indication of normal operation.

- If an abnormal condition exists, the LED will flicker rapidly for 350ms as an alert, and will then flash from one to seven times, 50ms on, 350ms off (see Fig. 2-27). Table 2-1 explains the meaning of the number of flashes.

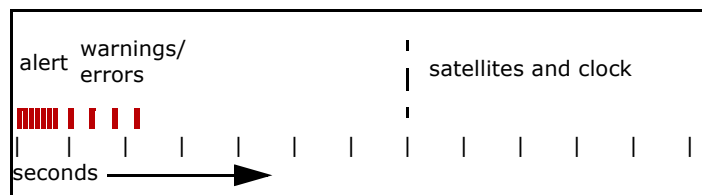


Fig. 2-27: Pattern of flashes indicating errors and warnings.

Table 2-1: Error and warning LED indications

Flashes	Message type	Meaning
1	Warning	Battery voltage is less than 11V.
2	Error	CompactFlash card is not installed.
3	Warning	Instrument internal temperature exceeds 60°C.
4	Warning	Instrument is in record mode but disk space is <50MB (AMT), <10MB (MT), or <2MB. The 50MB and 10MB warnings appear for 5 minutes only. The 2MB warning is continuous.
5	Warning	The number of saturated records has increased.
6	—	Measured electrode resistance exceeds acceptable maximum.
7	Error	Calibration failed.
8-14	—	Reserved for future use.

System error. In some circumstances, the instrument may not be able to start up normally. This problem can be caused by damaged circuit boards or corrupt firmware files, for example.

- In the case of a fatal system error, the LED flashes constantly, 100ms on, 100ms off (see Fig. 2-28).



Fig. 2-28: Pattern of flashes indicating system error.

If the instrument displays this indication, contact Phoenix technical support.

Satellite lock. To synchronize with UTC and begin data acquisition, transmitter control, or calibration, the instrument must receive signals from at least four GPS satellites. (The instrument may actually acquire up to eight satellites, but only indicates the first four.) Under normal conditions, satellite lock takes less than 10 min. A longer delay may indicate poor antenna positioning or a faulty antenna or cable.

- After the 7-second instrument status indication, the LED pattern is 250ms on, 250ms off, for each satellite acquired, for up to four satellites (see Fig. 2-29). If no satellites have been acquired, the pattern is 1.9s on, 0.1s off (see Fig. 2-30).

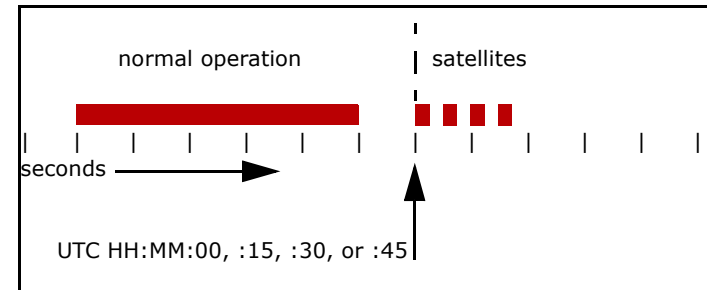


Fig. 2-29: Pattern of flashes indicating four (or more) satellites acquired.

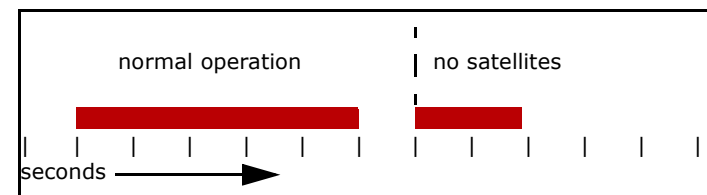


Fig. 2-30: A single long flash indicates zero satellites acquired.

Clock status. Once the instrument acquires the minimum number of satellites, the on-board clock synchronizes to GPS time. Within the following 12.5min, the satellites send a correction message and the on-board clock synchronizes to UTC. (The difference between GPS time and UTC is the number of UTC leap seconds, which are not incorporated in GPS time.) If satellite lock is subsequently lost, accurate time is maintained by an oven-controlled crystal oscillator (OCXO). Recording of site data or calibration data cannot begin unless the clock is synchronized to either satellites or OCXO.

- After the satellite indication, the LED pattern is 250ms on, 250ms off, from zero to four times (see Fig. 2-31). Table 2-2 explains the meaning of the number of flashes.

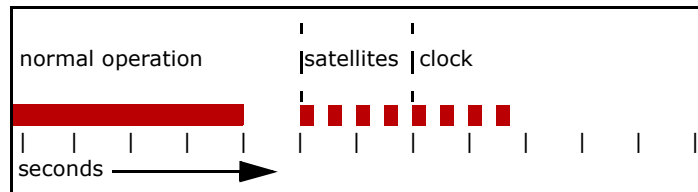


Fig. 2-31: Pattern of flashes indicating clock status.

Table 2-2: Clock status LED indications

Flashes	Meaning
0	Clock is not yet initialized.
1	Clock is synchronized to CPU real-time clock.
2	GPS synchronization is in progress.
3	Clock is synchronized to OCXO.
4	Clock is synchronized to GPS or UTC.

A complete pattern of eight equally spaced flashes indicates both satellite lock and clock synchronization to GPS or UTC. The instrument is ready to record site data or calibration data.

Instrument mode. The next four seconds of the sequence indicate whether or not the instrument is measuring electrode resistance or recording site data or calibration data. The possible instrument modes are: setup, standby, measuring resistance or recording data, or idling after recording.

- In these four seconds of the sequence, the LED pattern is 900ms on, 100ms off, from one to four

times (see Fig. 2-32). Table 2-3 explains the meaning of the number of flashes.

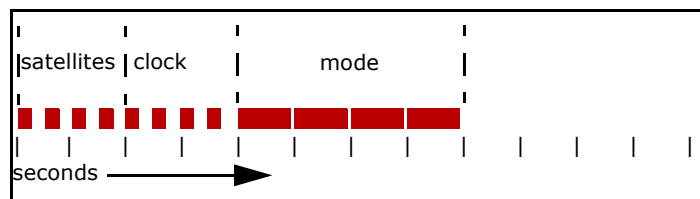


Fig. 2-32: Pattern of flashes indicating instrument mode.

Table 2-3: Instrument mode LED indications

Flashes	Meaning
1	Instrument is in Setup mode.
2	Instrument is standing by before recording or calibrating.
3	Instrument is measuring electrode resistance or recording site data or calibration data.
4	Instrument is idling after measuring electrode resistance or recording site data or calibration data.

Summary of complete sequence. Figure 2-33 shows the complete 15s indication sequence. In summary:

- Constant rapid, equally spaced flashes indicate a fatal system error.
- A fast flicker followed by very short flashes indicates an error or warning.
- A steady 5-second light indicates normal operation; be prepared to read the satellite count and clock status after this light goes off.
- A steady 1.9s light indicates no satellites acquired
- Short, equally spaced flashes indicate satellite and clock status; eight flashes in a row means the instrument is fully synchronized and ready to record.
- Longer flashes with a short space between them indicate setup or recording mode.

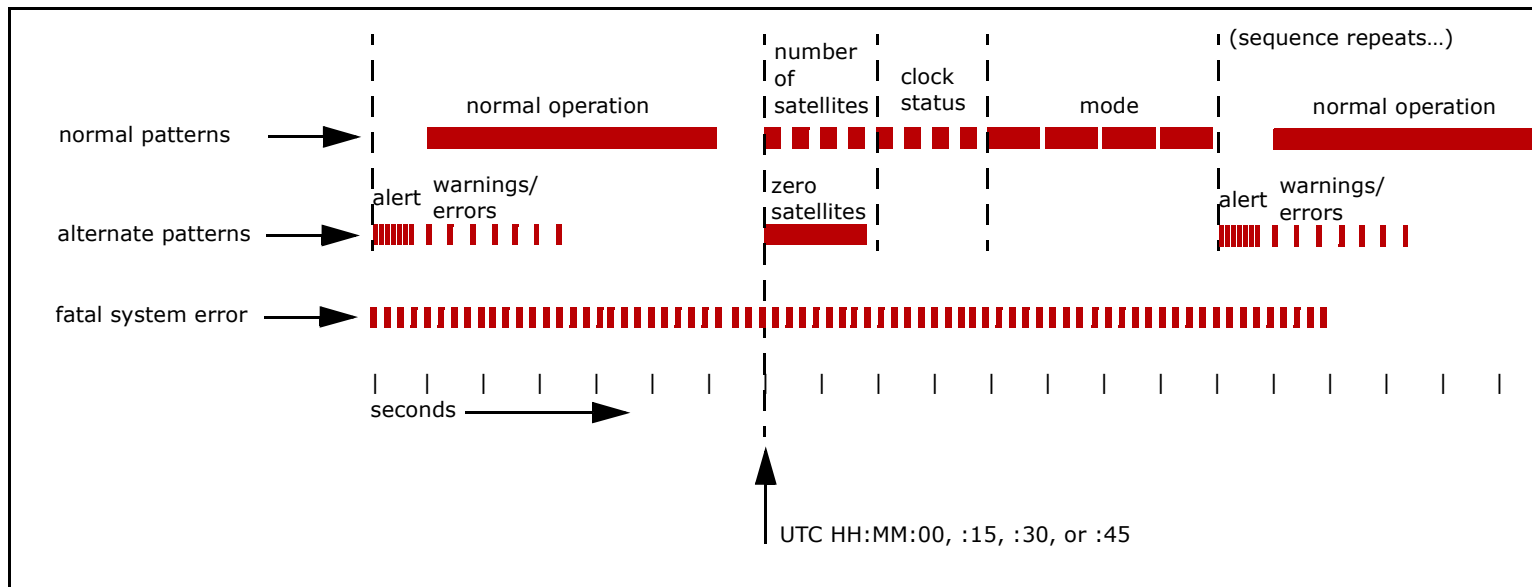


Fig. 2-33: Complete new indication sequence.

Examples. The following figures show examples of LED indications under various conditions.

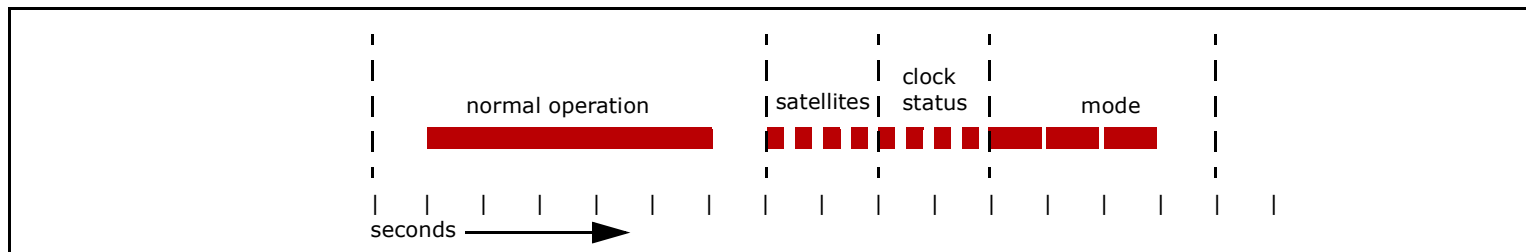


Fig. 2-34: Example of normal operation in record mode (site data or calibration data), or measuring electrode resistance.

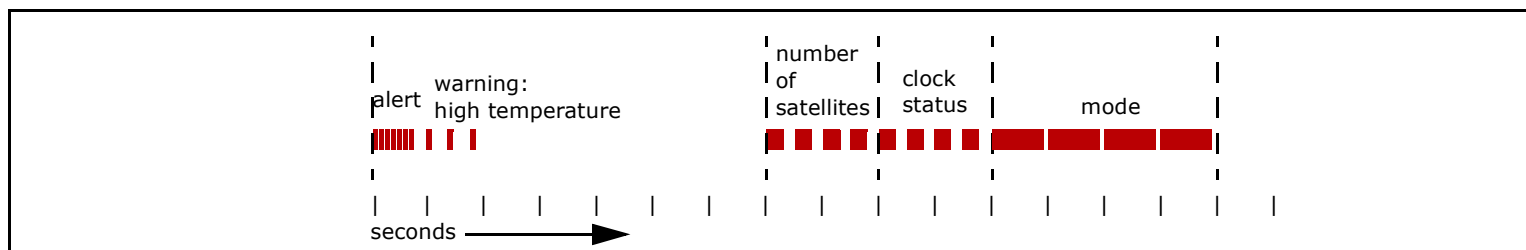


Fig. 2-35: Example of idling after acquisition with internal temperature exceeding 60°C.

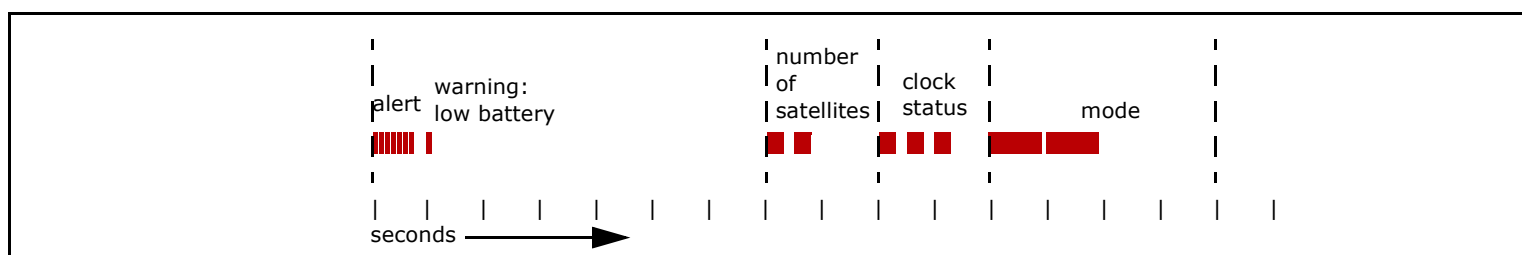


Fig. 2-36: Example of operation in standby mode when synchronized to OCXO, with a low battery warning.

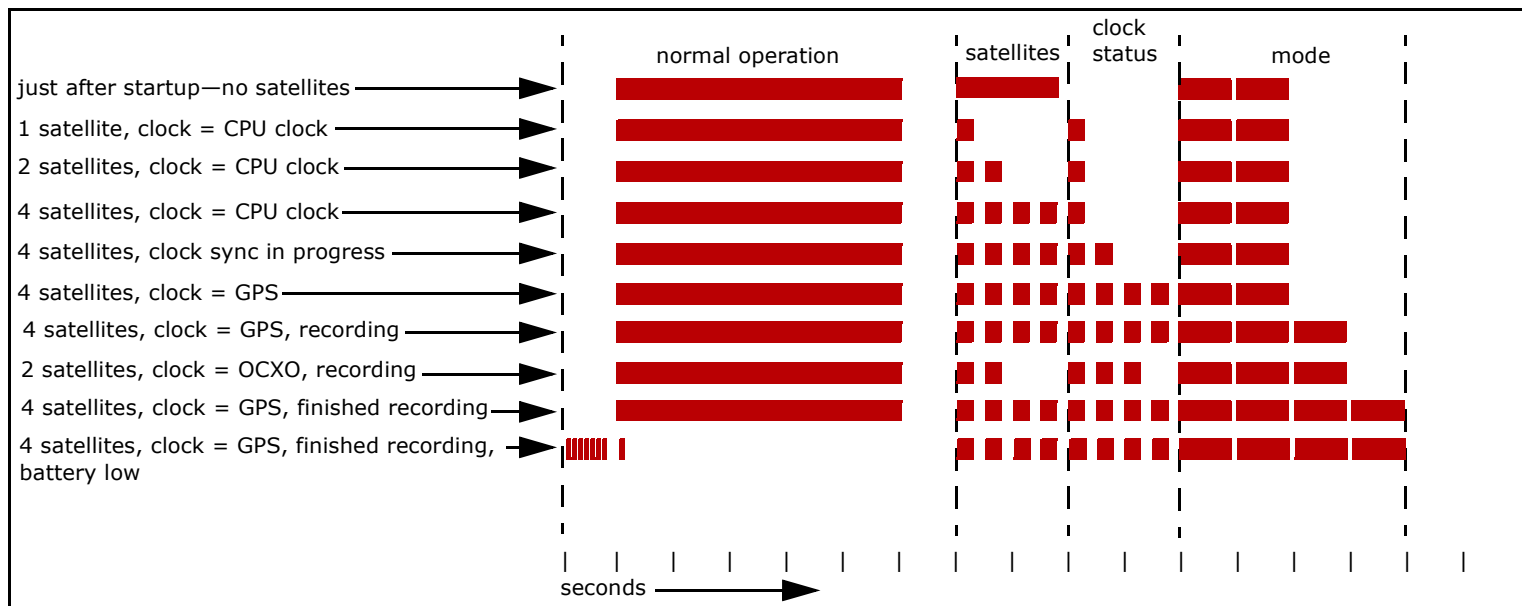


Fig. 2-37: Example of how the pattern might change during a normal sounding. At first there are no satellites acquired, then 1 satellite, then 2, then 4 or more. As satellites are acquired, the clock synchronizes first with the CPU, then with GPS/UTC. At the programmed start time, the mode changes from standby to record mode. Satellites may be lost temporarily, leaving the clock synchronized to the OXO while recording continues. Recording stops at the programmed time and the instrument idles, possibly draining the battery below 11V.

Using the new indication sequence

If you have a PC connected to the instrument, you can use WinHost to learn the details of GPS synchronization, instrument mode, and so on. However, the LED indications give you a quick way to learn if everything is operating as expected, without needing a PC in the field.

The most important indication is the steady 5-second light. This light tells you that the instrument is operating normally. If you see an alert and warning or error indication instead, take immediate steps to correct the cause.

If the 5-second light indicates normal operation, then watch the following flashes to learn the satellite and clock status. For several minutes after powering on, you should expect to see the 1.9s zero-satellite indication and a clock indication of zero flashes. After a few minutes the satellite indication will change to show the number of satellites acquired and the clock indication will show one or two flashes to indicate progress in synchronizing.

Once the satellite indication reaches four flashes, you should see the clock indicator also change to four flashes. Taken together, these eight identical flashes indicate full GPS and clock synchronization.

After the clock is synchronized, you may see the number of satellites drop to less than four; at that point, the clock status will change to three flashes to indicate synchronization to the crystal oscillator. This is also a normal condition.

Finally, check the longer flashes of the mode indication. If you are recording or calibrating, you should see three flashes. When calibration is complete or data recording has ended according to a schedule, you will see four flashes. If you have scheduled the instrument to record automatically at a later time, you should see two flashes.

If the LED indications are not what you expect to see, use the WinHost program to find out where the problem lies.
