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J1939-15, Device Communication Reference (250Kbit/s)

The information below is designed to help Engineers and other network professionals quickly integrate and use Floyd Bell's CAN devices on their network. It is important to understand that Floyd Bell CAN devices do not have "pre-configured" sounds or light variations but are configurable for many different sounds or light variations via the messages received on the network. This is done so that the Floyd Bell device is useful for multiple alarm conditions. As a result, one could have a unique sound or light variation for each alarm condition in your application.

To date, this document serves as a communication reference for CAN Alarm, CAN light and Twin CAN (alarm and light) products. All three products will respond according to the below information.

Activation and configuration of the device is achieved by way of the CAN interface using the SAE J1939-15 protocol at 250kbit/s baud rate. It is not the intent of this document to give full and complete instruction concerning CAN networks or the J1939 protocol; however, if this level of instruction is necessary we recommend reading "A Comprehensible Guide to J1939" by Wilfried Voss and "Controller Area Network" by Konrad Etschberger.

PGN 60928 (0xEE00) Address Claimed

The Floyd Bell CAN device family is arbitrary address capable, meaning they can claim a different address if an address conflict occurs. Upon power up, the Floyd Bell CAN device will notify other devices on the network that it is claiming its preferred address in accordance with J1939-81. The preferred address is 130 (0x82). If the Floyd Bell CAN device discovers that another device on the network is claiming the same address, and the device's name is of higher priority (lower numeric value), the Floyd Bell CAN device will claim a different address. The Floyd Bell CAN device will monitor all address claim messages and build an internal table of unavailable addresses to aid in picking an unclaimed new address.

If, for some reason, the address claim process is unsuccessful, the Floyd Bell CAN device will send a "Cannot Claim Address" message and it will claim the NULL address of 254 (0xFE).

PGN 59904 (0xEA00) Request

As defined in J1939-21, the “Request PGN” message can be used to solicit the transmission of any PGN, either by a single device (with a specific destination address) or by all devices (using the global destination address). All Floyd Bell CAN devices will respond to network requests. The Floyd Bell CAN devices will listen to incoming requests for “Address Claimed” PGN 60928 (0xEE00) and “Software Identification” PGN 65242 (0xFEDA) and response accordingly.

The request PGN 0xEA00 can be used to ascertain the health and status of the Floyd Bell Device. For example, if CAN Alarm is currently sounding with a siren tone as shown in example #4, the data field returned with this request will contain 0xD750675000000000. This data tells the requesting ECU that the alarm is, indeed, functioning and currently sounding as a siren. It is important to note that the data field, included with the response, contains the last known operational state of the alarm.

Note: In the event of a power failure, all Floyd Bell CAN devices reset during power up; therefore, all data returned would indicate the default or “off” state of the device.

PGN 65361 (0xFF51) Operator Alert Control – Alarm

For devices that have piezo sounders, proprietary PGN 0xFF51 is used to configure and control the sounds of your Floyd Bell CAN device. PGN 0xFF51 will be used to “turn on”, “turn off” and configure Alarm sounds while on the network. If the Floyd Bell CAN device is turned on, the device will play a specific alarm sound and alarm sound pattern. The associated message data of this PGN will provide all of the configuration bits for your chosen sound type and pattern. Your alarm may sound as a standard *Beep, Beep, Beep*, or a *siren* or maybe even sound like a *car door chime*. Any of these and many more sounds are available through properly setting bits in the message data field. In short, you can create your own custom sounds.

PDU2 Format:

| | |
|------------------------------|-----------------------|
| Transmission Repetition Rate | As required |
| Data Length | 8 bytes |
| Data Page | 0 |
| PDU Format: PF | 255 (0xFF) |
| PDU Specific: PS | 81 (0x51) |
| Priority | 6 (0x6) |
| PGN | 65361 (0xFF51) |

Data Field SPN:

| Byte # | Length | Parameter Name |
|--------|--------|---|
| 1 | 1 Byte | Sound Segment 1: Return segment bit, Sound type, Volume |
| 2 | 1 Byte | Sound Segment 1: On time, Off time |
| 3 | 1 Byte | Sound Segment 2: Return segment bit, Sound type, Volume |
| 4 | 1 Byte | Sound Segment 2: On time, Off time |
| 5 | 1 Byte | Sound Segment 3: Return segment bit, Sound type, Volume |
| 6 | 1 Byte | Sound Segment 3: On time, Off time |

| | | |
|---|--------|---|
| 7 | 1 Byte | Sound Segment 4: Return segment bit, Sound Type, Volume |
| 8 | 1 Byte | Sound Segment 4: On time, Off Time |

Data Parameters Explained:

The message data field is broken up into 4 identical segments. (See Figure 1.) Each segment has an identical set of variables. These variables include the following . . .

- Return segment bit – will it repeat and where
- Sound – type of sound
- Volume – how loud is the alarm
- On time – how long sound remains
- Off time – how long sound is off

The Floyd Bell CAN device will play audio described in each segment in order from Segment 1 to Segment 4 thus providing a pattern. (See Figure 1.) It will attempt to return and repeat only if a return segment bit is set in one of the segments. If the return segment bit is set in one of the sound segments, it will return indefinitely to that segment and keep playing, thus providing a looping affect to the pattern. Later in this document you will see a number of examples that use the return segment bit.

A pattern will end with the first segment who's "on" and "off" times are both set to 0, or after it plays through segment 4. The pattern can be made to play only once or repeat indefinitely as described above.

*If a pattern is set to repeat indefinitely, it can be turned off by transmitting "Operator Alert Control" as described below in **Example 2- Alarm off**.*

Referring to figure 1, the data of the operator alert message is divided into 4 segments of 2 bytes each. Bits 0 - 3 of the first byte in a segment specifies the volume level for the segment, 0x1 being the softest and 0xA the loudest. A volume level of 0x0 is no sound (mute). The type of sound, (single tone, frequency sweep up, frequency sweep down, or chime) is controlled by bits 4 – 6. Bit 7, the "return segment" bit, determines if this is the first segment to be repeated. In other words, if bit 7 is set to 1, play will start over with this segment when the pattern end is reached.

The second byte in the segment controls the timing. The upper nibble, bits 4 – 7, sets the "on" time and the lower nibble, bits 0 – 3, sets the "off" time to the values listed in the table. A segment can have just "on" time or just "off" time, or both. If a segment has both on time and off time, the "on" time is used first followed by the "off" time. Please note that if the volume is set to mute, the "on" time will produce no sound output. This is useful for creating extended time with no sound in a particular pattern. For example, it is possible to have a segment produce 6 seconds of "off" time (3 seconds of muted "on" time and 3 seconds of "off" time).

The example in Figure 1 produces a beep tone, 1800 Hz for 250 mSec and no sound for 250 mSec. Since bit 7 of byte 1 in segment 1 is set to 1, and both the "on" and "off" times are 0 in segment 2, segment 1 will repeat indefinitely.

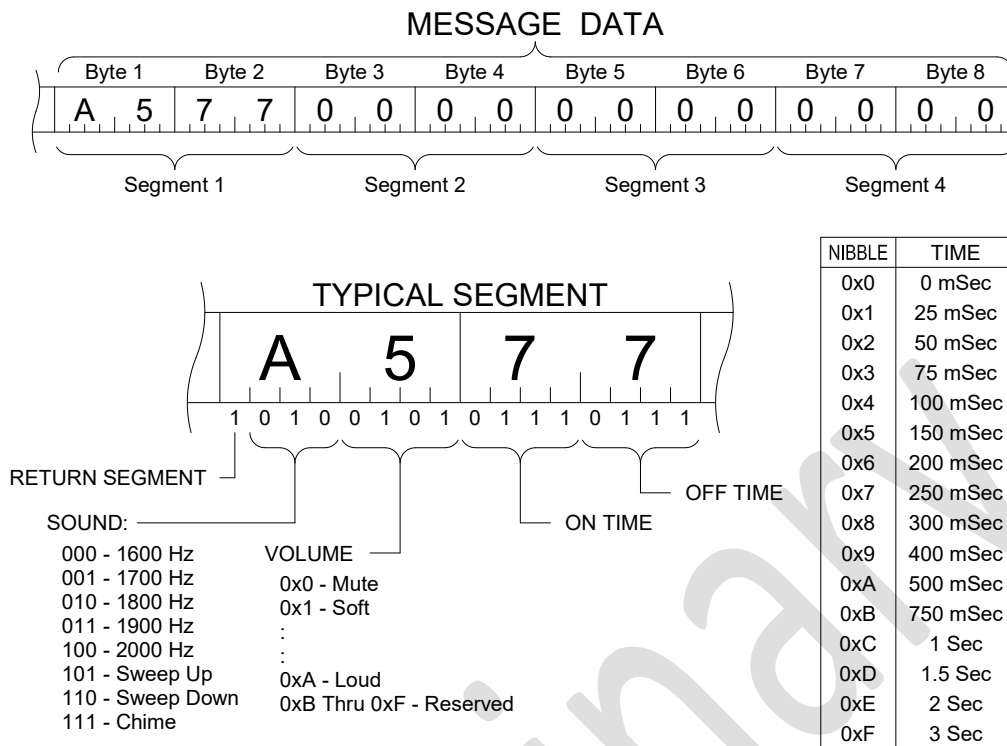


Figure 1

In order to stop the beeping sound, “operator alert control” PGN is again sent with all data bits in the message data set to 0. Please refer to Example 2.

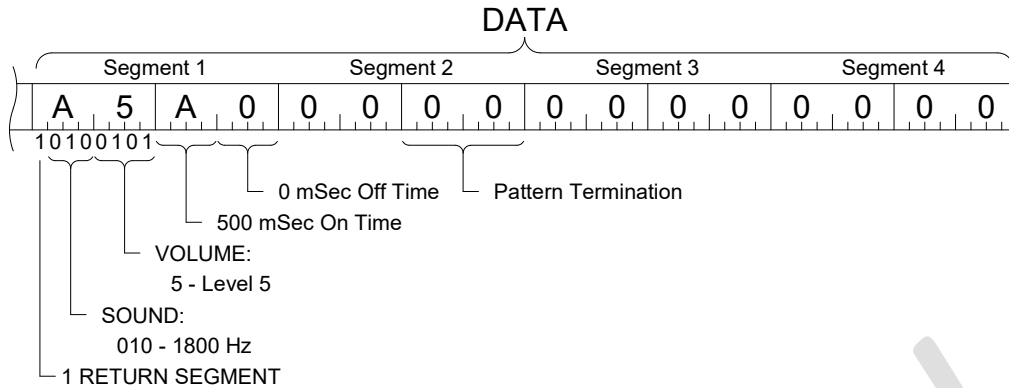
Note:

If the user finds that the proprietary broadcast PGN 65361 (0xFF51) is already assigned on the network for other purposes, a “special product” with a unique PGN can be developed with the assistance of Floyd Bell. If this situation arises, please contact sales@floydbell.com or call 614-294-4000.

EXAMPLES of PGN 65361 (0xFF51) “Operator Alert Control”

Example 1 – Constant On

In this example, the message data field is set such that the Floyd Bell CAN device will sound with a continuous tone of 1800 Hz at volume level 5 until stopped by a following “operator alert control.” (See example 2.) The continuous tone is created by one segment of “on” time and no “off” time and the “return segment” bit set to 1. This one segment plays over and over. Since there is no off time, the sound appears continuous. The “on” time in the example is set to 500 mSec, but it could be set to any value other than 0 and the result would be the same.

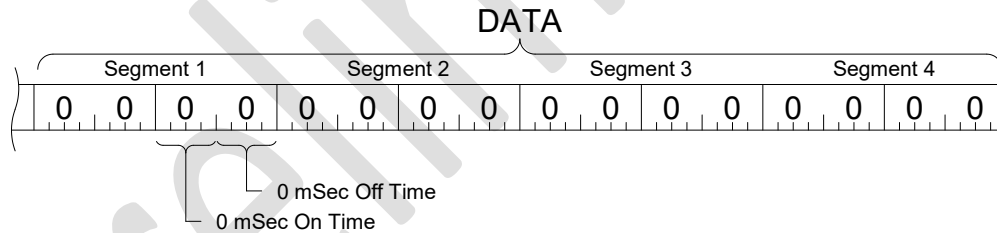


Example 1. Continuous

Example 2 – Alarm Off

Sending an “operator alert control” with all the segment volumes set to 0 will silence the alarm; however, the following is the preferred method to silence the alarm.

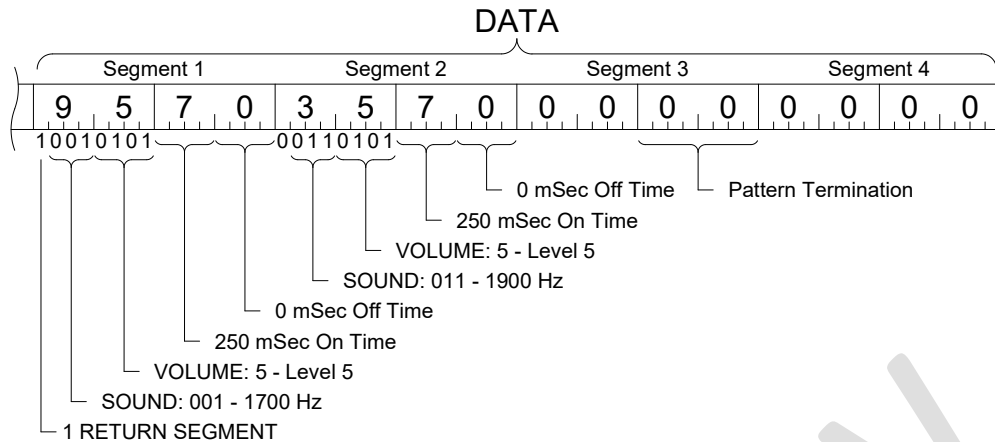
The **preferred method**: Send an “operator alert with all zero’s in the data field. When the alarm receives this message the alarm turns off. Electrically, this command disables the output stage of the alarm which in turn silences the alarm. Subsequent messages that should produce sound will automatically re-enable the output.



Example 2. Alarm Off

Example 3 – Warble (Two Frequencies) – “Similar to English police siren”

For this example, the alarm will sound at a low frequency and then abruptly switch to a higher frequency. This pattern will repeat indefinitely or until a following “operator alert control” command is sent. (see example 2) In our example below, the alarm tone is set to repeat as shown in bit 7 of segment 1. The alarm will start at 1700hz at a volume level of 5 and will remain on for 250mSec as shown in the table below. (see segment 1). The alarm will then change to a 1900hz tone at a volume level of 5 and will remain on for 250mSec. (see segment 2) Since all the bits of segment 3 are set to zero, the software will seek to repeat to wherever it finds a return segment bit set. Again, since bit 7 of Segment 1 is set, it will return to this point and repeat, thus creating the two tone nature of the “English police siren.”

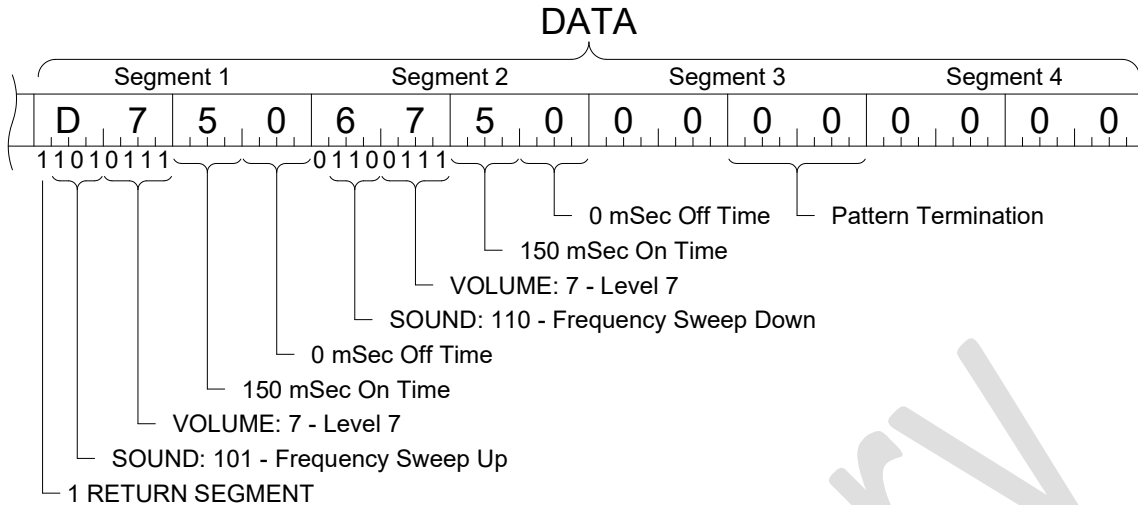


Example 3. Warble (Two Frequencies)

Example 4 – Siren (Frequency Sweep) – “Similar to what you hear on many car alarms”

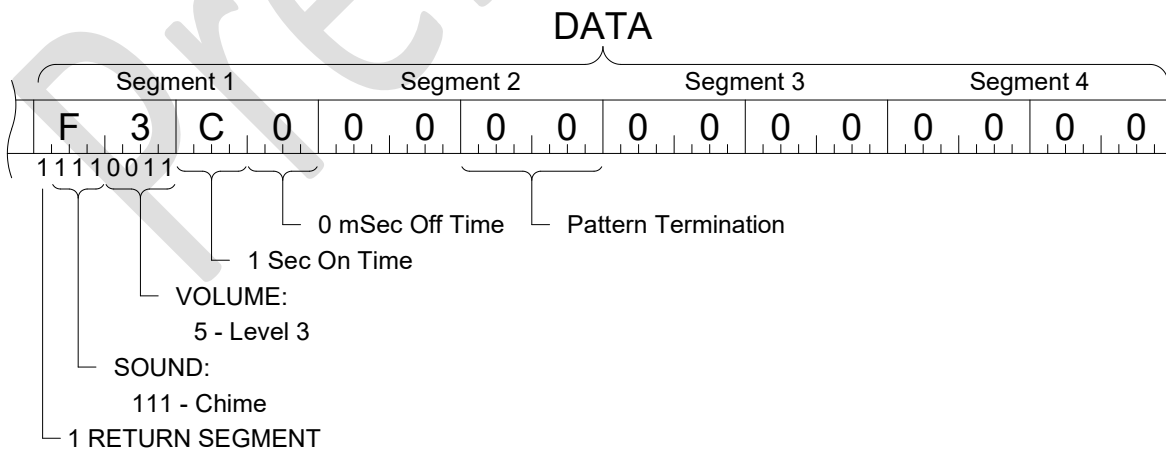
In this example the tone will begin sounding at a low frequency (1600Hz) and linearly sweep up to a high frequency (2000Hz) and then sweep back down to the low frequency. This action of sweeping the frequency is a very attention getting sound. There are two affects that make this a very noticeable tone. First, it uses a wide bandwidth of tones as it sweeps. The wide bandwidth makes the tone very hard to ignore especially in a loud and noisy environment where a single tone may get “washed out” by other noise. Second, during the sweep, the “hot spot” or resonant frequency of the alarms tone cavity is fully utilized. This affect tends to give a piercing audible feeling to the listener.

In our example below, the Floyd Bell CAN device’s tone is set to repeat. This is accomplished via segment 1, bit 7 (MSB). The alarm is configured to utilize a frequency “sweep up” by bits 6, 5, and 4 in segment 1 (MSB) according to the sound table shown in figure 1. The sweep up is set to volume level 7 as shown below. The “on time” for the sweep up is set to 150mSec and there is no off time for the sweep. Next, the alarm is configured to sweep back down as shown by bits 6, 5, and 4 in segment 2 (MSB). Notice that bit seven is set to 0. This means that when the software returns, it will return to segment 1. This will happen because bit 7 of the MSB is set to 1. Again, the sweep down is configured to have volume level 7 and 150mSec sweep down time. There is no off time for the sweep down. Since segment 3 is all zero’s the software will return to segment 1 and the process will repeat until an “operator alert control” command is given. (See example 2).



Example 5 – Chime (single tone decay) – “similar to what you hear with many automotive door chimes”

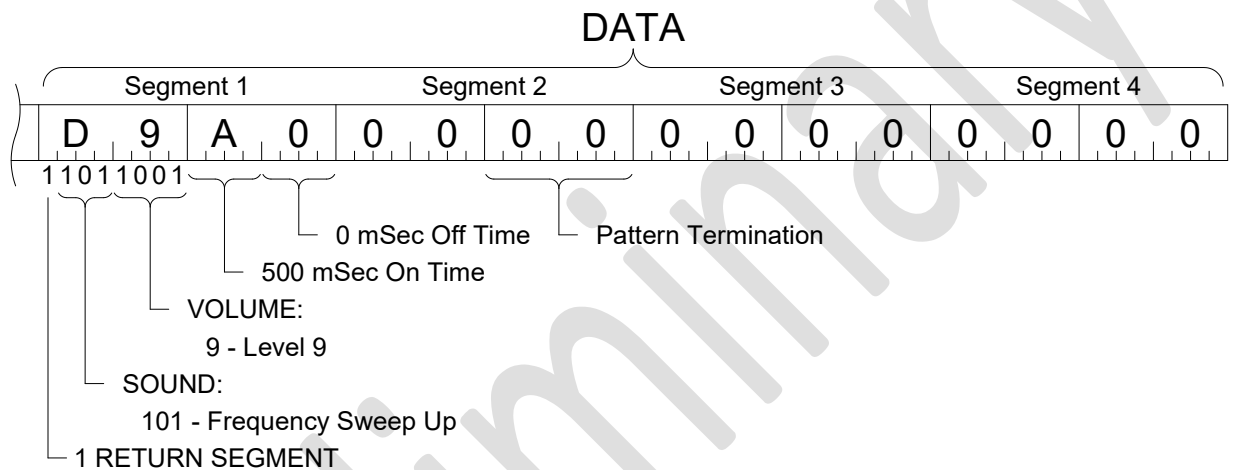
In this example the tone will be set to what is called a “chime” tone. Chime is considered by most people to be a pleasant sound. This is why the automotive companies use it for door open indicators. This tone is a single frequency tone that is decayed, in volume level over time. If this tone were set to *not repeat*, it would be very similar to the sound of striking a bell with a hammer. The bell would ring at its resonant frequency and the volume level would decay over time. The overall volume level of the bell would be controlled by the force at which the hammer hits the bell. In our case, we will control the overall volume as shown below with the data bits in segment 1. In our example below, the volume is set to Level 3. The one second on time, as set in the LSB of segment 1, will be the duration of time that the chime will ring. As in the other examples above, since bit 7 (MSB) in segment 1 is set to 1, the software will return here and keep chiming until an “operator alert control” command is received. (See example 2).



Example 6 – Whoop (Frequency sweep) – “Many people consider this a chirp sound”

This tone is also a frequency sweep but in one direction only and then it abruptly resets to the lowest frequency. It is truly one half of a siren tone. The whoop tone has all the frequency sweep advantages of the siren, as described above, but with some added benefits. This tone is *not as common* of a noise as a standard siren and it is highly desirable when the alert could be confused with other alarms or simply ignored because it sounds so “common.”

In the example below bit 7 (MSB) of segment 1 is set; therefore, the tone will repeat. Bit’s 6, 5, and 4 (MSB) are configured the same as the siren for a sweep up. The volume, as shown below is set to level 9. The on time is 500mSec as shown below and there is no off time. The pattern will return to the beginning in segment 2 as all bits are set to zero. As with our other examples, this tone will repeat indefinitely until “operator alert control” is received as described in example 2.



Example 6. Whoop

Example 7 – Staccato (Frequency sweep) – “Very attention getting sound”

The staccato tone is exactly the same as the Whoop tone but with a much faster frequency sweep. This is considered by some to be the most attention getting sound in Floyd Bell’s line up of tones. To make a Staccato from the whoop example, simply shorten the 500mSec on time of the alarm. When the alarm on time is shortened the sweep rate is increase. In other words, the time it takes to sweep from min frequency to max frequency is shortened. To make a Staccato tone it is recommended to change the on time to 150 mSec. One could experiment with on time to a desired rate.

PGN 65360 (0xFF50) Operator Alert Control – Light

For devices that have this functionality, PGN 0xFF50 will be used to “turn on”, “turn off” and configure the Light’s behavior while on the network. The associated message data of this PGN will provide all of the configuration bits for your chosen light behavior and pattern. Your Floyd Bell light device may light up with constant illumination or it may flash on and off much like many other indicators. The device could also ramp up to full brightness and ramp down to minimal brightness giving a pulsating affect instead of flashing. Any of these and many more light configurations are available through properly setting bits in the message data field. In short, you can create unique light affects not available in most products.

PDU2 Format:

| | |
|------------------------------|-----------------------|
| Transmission Repetition Rate | As required |
| Data Length | 8 bytes |
| Data Page | 0 |
| PDU Format: PF | 255 (0xFF) |
| PDU Specific: PS | 80 (0x50) |
| Priority | 6 (0x6) |
| PGN | 65360 (0xFF50) |

Data Field SPN:

| Byte # | Length | Parameter Name |
|--------|--------|---|
| 1 | 1 Byte | Light Segment 1: Return segment bit, Light Mode, Brightness |
| 2 | 1 Byte | Light Segment 1: On time, Off time |
| 3 | 1 Byte | Light Segment 2: Return segment bit, Light Mode, Brightness |
| 4 | 1 Byte | Light Segment 2: On time, Off time |
| 5 | 1 Byte | Light Segment 3: Return segment bit, Light Mode, Brightness |
| 6 | 1 Byte | Light Segment 3: On time, Off time |
| 7 | 1 Byte | Light Segment 4: Return segment bit, Light Mode, Brightness |

Data Parameters Explained:

The message data field is broken up into 4 identical segments. (See Figure 2.) Each segment has an identical set of variables. These variables include the following . . .

- Return segment bit – will it repeat and where
- Light Mode – Constant on, Increasing Brightness, Decreasing Brightness
- Brightness – Light Brightness.
- On time – how long light is on
- Off time – how long light is off

The Floyd Bell CAN device will illuminate as described in each segment in order from Segment 1 to Segment 4 thus providing a pattern. (See Figure 2.) It will attempt to return and repeat only if a return segment bit is set in one of the segments. If the return segment bit is set, in one of the light segments, it will return indefinitely to that segment and keep repeating, thus providing a looping affect to the pattern.

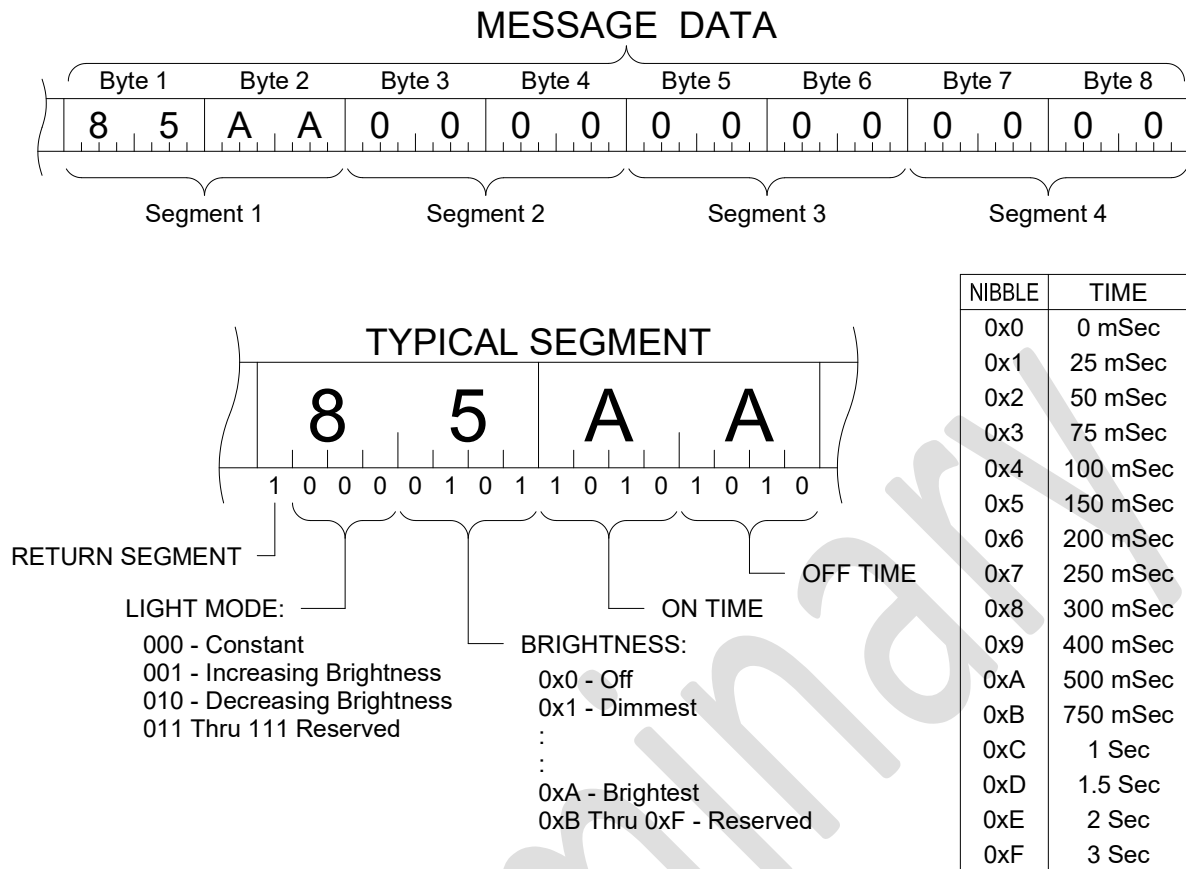
A pattern will end with the first segment who's "on" and "off" times are both set to 0, or after it completes segment 4. The pattern can be made to illuminate only once or repeat indefinitely as described above.

*If a pattern is set to repeat indefinitely, it can be turned off by transmitting "Operator Alert Control" with all zeros in the data field for all four segments. **This is the preferred way to turn the light off.***

Referring to figure 2, the data of the operator alert message is divided into 4 segments of 2 bytes each. Bits 0 - 3 of the first byte in a segment specifies the Brightness level for the segment, 0x1 being the Dimmest and 0xA the Brightest. A Brightness level of 0x0 is off. The Light Mode or behavior (Constant, Increasing Brightness, or Decreasing Brightness) is controlled by bits 4 – 6. Bit 7, the "return segment" bit, determines if this is the first segment to be repeated. In other words, if bit 7 is set to 1 in any of the segments, the illumination pattern will start over with this segment when the pattern end is reached.

The second byte in the segment controls the timing. The upper nibble, bits 4 – 7, sets the "on" time and the lower nibble, bits 0 – 3, sets the "off" time based on values listed in the table of Figure 2. A segment can have just "on" time or just "off" time, or both. If a segment has both on time and off time, the "on" time is used first followed by the "off" time. Please note that if the Brightness is set to off, the "on" time will produce no light output. This is useful for creating extended time with no light in a particular pattern. For example, it is possible to have a segment produce 6 seconds of "off" time (3 seconds of light "on" time and 3 seconds of light "off" time).

The example in Figure 2 produces a "blinking" light with .5sec on time and .5seconds off time. Since bit 7 of byte 1 in segment 1 is set to 1, and both the "on" and "off" times are 0 in segment 2, segment 1 will repeat indefinitely. *In other words, if this data is sent to the light, it will begin to flash and will not stop until an Operator Alert Control is sent with the data field set to all zeros.*



| NIBBLE | TIME |
|--------|----------|
| 0x0 | 0 mSec |
| 0x1 | 25 mSec |
| 0x2 | 50 mSec |
| 0x3 | 75 mSec |
| 0x4 | 100 mSec |
| 0x5 | 150 mSec |
| 0x6 | 200 mSec |
| 0x7 | 250 mSec |
| 0x8 | 300 mSec |
| 0x9 | 400 mSec |
| 0xA | 500 mSec |
| 0xB | 750 mSec |
| 0xC | 1 Sec |
| 0xD | 1.5 Sec |
| 0xE | 2 Sec |
| 0xF | 3 Sec |

Figure 2

Note:

If the user finds that the proprietary broadcast PGN 65360 (0xFF50) is already assigned on the network for other purposes, a “special product” with a unique PGN can be developed with the assistance of Floyd Bell. If this situation arises, please contact sales@floydbell.com or call 614-294-4000.

Revisions Page

| Rev # | Date | Description |
|--------------|-------------------|--|
| 0 | 1/22/2019 | New document |
| 0.1 | 4-29-2019 | Add full list of examples |
| 1.0 | 8/19/2019 | Change PGN "operator alert" from EF00 to FF51 to avoid conflicts, remove acknowledgement section of document |
| 1.1 | 9/10/2019 | Add further clarification concerning Operator Alert Control PGN 65361 (0xFF51) This includes the following: priority level, chart for PDU2 Format and Data field chart. |
| 1.2 | 12/16/2019 | Add instructions for Light products (PGN 0xFF50), add clarification concerning PGN 59904 (0xEA00) Request. |
| 1.3 | 8/31/2020 | Add baud rate and J1939-15 to reference document for clarity. |

Preliminary