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CAN Alarm Communication Reference

The information below is designed to help Engineers and other network professionals quickly integrate and use the Floyd Bell CAN alarm on their network. It is important to understand that the alarm does not have "pre-canned" tones but is configurable for many different sounds or tones via messages received on the network. This is done so that the alarm is useful for multiple alarm conditions. As a result, one could have a unique sound for each alarm condition.

Activation and configuration of the alarm is achieved by way of the CAN interface using the SAE J1939 protocol. 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 CAN-96-930 is arbitrary address capable, meaning it can claim a different address if an address conflict occurs.   Upon power up, the CAN-96-930 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 CAN-96-930 discovers another device on the network is claiming the same address, and the device's name is of higher priority (lower numeric value), the CAN-96-930 will claim a different address. The CAN-96-930 monitors all address claim messages and builds 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 CAN-96-930 will send a "Cannot Claim Address" message and it will claim the NULL address of 254.

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). The CAN-96-930 will listen to incoming requests for "Address Claimed" PGN 60928 and "Software Identification" PGN 65242 and response accordingly.

PGN 61184 (0xEF00) Operator Alert Control

Proprietary PGN 0xEF00 is used to activate or turn on the CAN-96-930 and it is also used to turn the CAN-96-930 off. If the CAN-96-930 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.

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

The CAN-96-930 will play audio described in each segment in order from Byte 1 to Byte 8 thus providing a pattern. (See Figure 1.) It will attempt to return and repeat only if the return segment bit it set in one of the segments. If one is set, 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 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 the example section.

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", 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.

MESSAGE DATA

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	A 5	7 7	0 0	0 0	0 0	0 0	0 0	0 0

Segment 1   Segment 2   Segment 3   Segment 4

TYPICAL SEGMENT

A 5 7 7

1 0 1 0 0 1 0 1 0 1 1 1 0 1 1 1

RETURN SEGMENT

SOUND:

000 - 1600 Hz
001 - 1700 Hz
010 - 1800 Hz
011 - 1900 Hz
100 - 2000 Hz
101 - Sweep Up
110 - Sweep Down
111 - Chime

VOLUME

0x0 - Mute
0x1 - Soft
:
:
0xA - Loud
0xB Thru 0xF - Reserved

ON TIME

OFF TIME

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 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.

PGN 59392 (0xE800) Acknowledgement

Upon receiving an "Operator Alert Control" PGN 61184, the CAN-96-930 will respond with an "Acknowledgement" PGN 59392 as shown in figure 2. Byte 5 is the source address of the device that sent the message being acknowledged. Byte 6 is the destination address from the message being acknowledged. The destination address could be either the specific address of the alarm or the global address 0xFF.

DATA

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	0 0	D F	F F	F F			E F	0 0

Source Address of Message Being Acknowledged

PGN of Message being Acknowledged - LSB

PGN of Message being Acknowledged

PGN of Message being Acknowledged - MSB

Figure 2

EXAMPLES of PGN 61184 (0xEF00) "Operator Alert Control"

Example 1 – Constant On

In this example, the message data field is set such that the CAN-96-930 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.
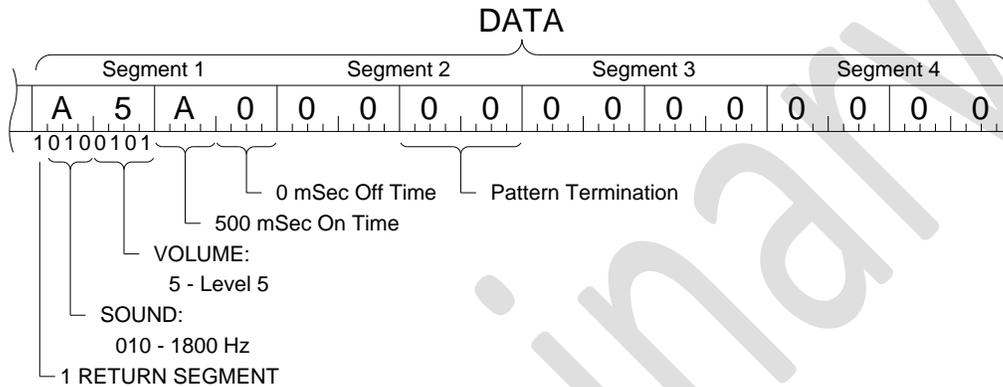
Example 1. *Continuous*

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 will 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.
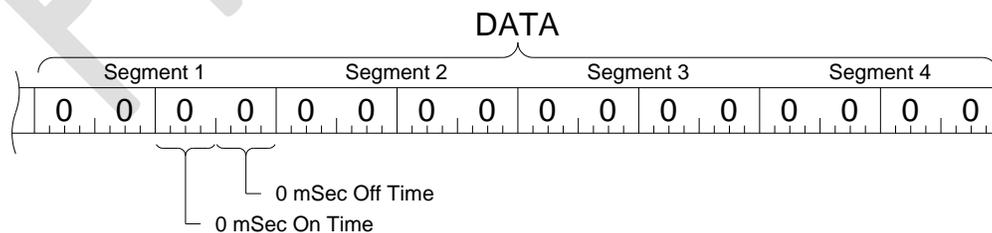
Example 2. *Alarm Off*

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."
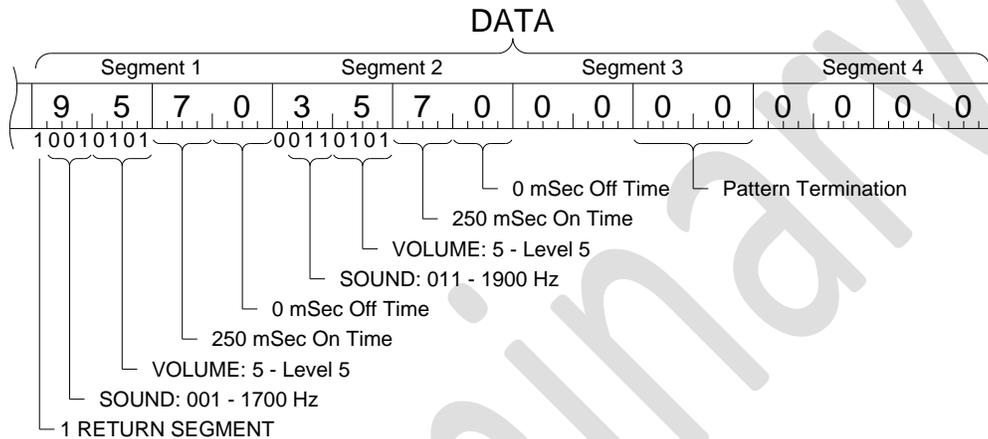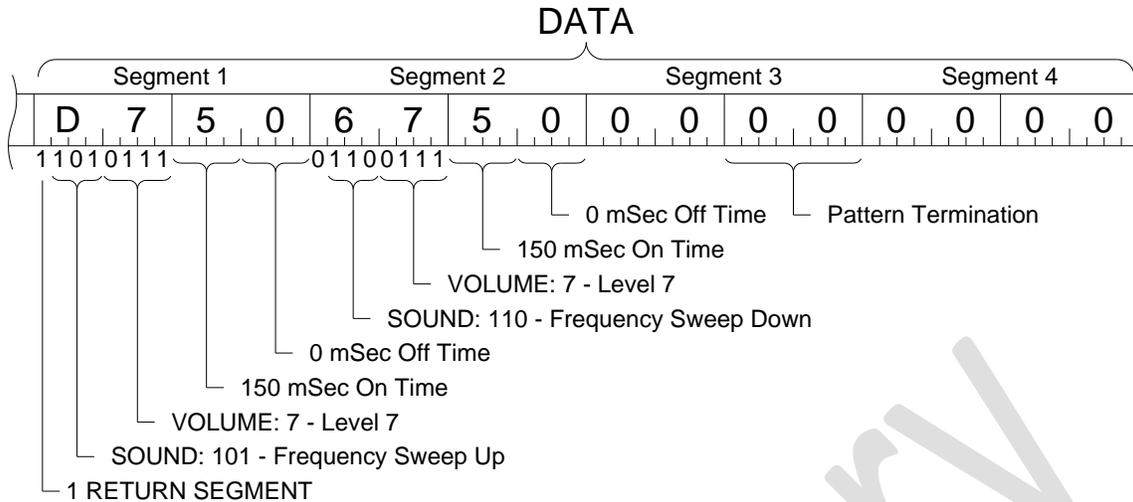

Example 3. *Warble (Two Frequencies)*

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 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 give a piercing audible feeling to the listener.
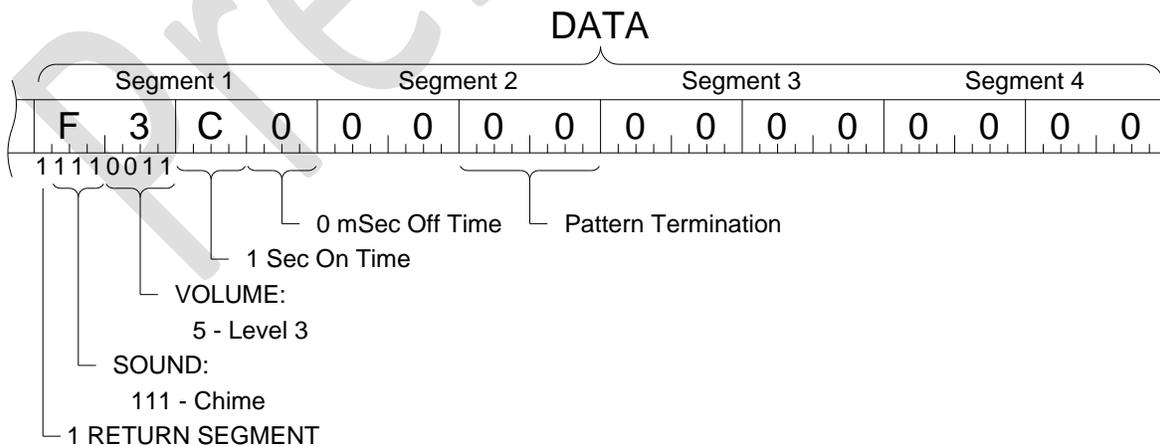
In our example below, the CAN-96-930s tone is set to repeat. This is accomplished via segment 1, bit 7 (MSB). The alarm is configured to utilize a frequency "sweep up" by bits 6, 5, and 4 in segment 1 (MSB) according to the sound table shown in figure 1. The sweep up is set to volume level 7 as shown 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).

DATA

Segment 1				Segment 2				Segment 3				Segment 4			
D	7	5	0	6	7	5	0	0	0	0	0	0	0	0	0

1 1 0 1 0 1 1 1   0 1 1 0 0 1 1 1

- 0 mSec Off Time
- Pattern Termination
- 150 mSec On Time
- VOLUME: 7 - Level 7
- SOUND: 110 - Frequency Sweep Down
- 0 mSec Off Time
- 150 mSec On Time
- VOLUME: 7 - Level 7
- SOUND: 101 - Frequency Sweep Up
- 1 RETURN SEGMENT

Example 4. Siren

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).
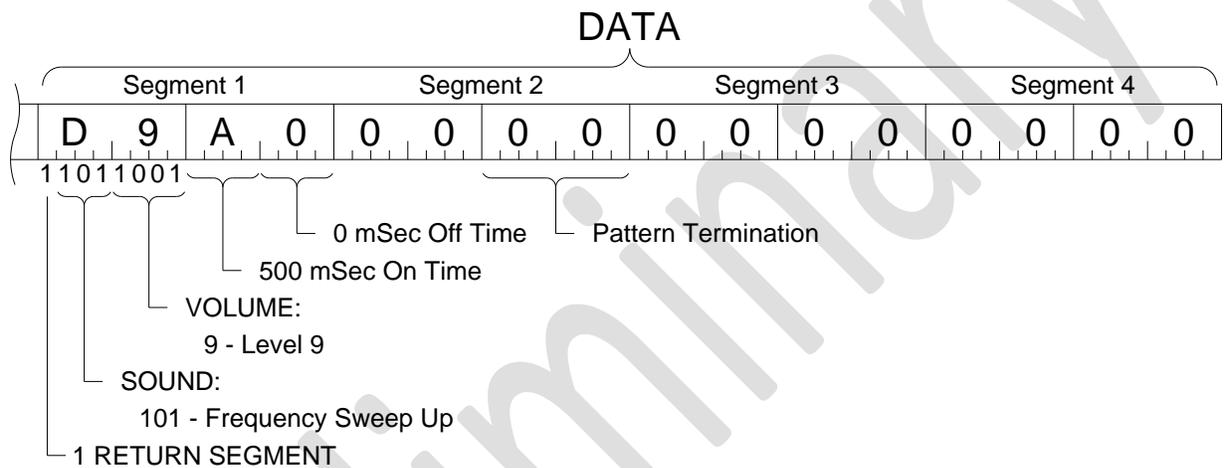
DATA

Segment 1				Segment 2				Segment 3				Segment 4			
F	3	C	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1 1 1 0 0 1 1

- 0 mSec Off Time
- Pattern Termination
- 1 Sec On Time
- VOLUME:
  5 - Level 3
- SOUND:
  111 - Chime
- 1 RETURN SEGMENT

Example 5. Chime

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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.

DATA

	Segment 1			Segment 2			Segment 3			Segment 4	
D	9	A	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1 0 1 1 0 0 1

— 0 mSec Off Time — Pattern Termination

— 500 mSec On Time

VOLUME:
  9 - Level 9

SOUND:
  101 - Frequency Sweep Up

1 RETURN SEGMENT

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.