Technical Description

Description of the system:

The combination of the In Vehicle Unit (IVU) and the keyfob HandHeld Unit (HHU) form an RF based two-way remote vehicle start system. The system operates at frequencies between 904 and 924.6 Mhz using Frequency Hopping Spread Spectrum transmission.

Description of Operation:

When the remote start button is pressed on the keyfob (HHU), a start command is transmitted to the vehicle's IVU. The IVU responds by sending a confirmation signal back to the keyfob causing the keyfob to emit a short beep and flash an LED one time. This tells the operator that the vehicle has received the command and is going to start the engine.

Once the engine has started the vehicle (IVU) sends another message back to the keyfob causing it to beep (and LED flash) two times.

If the keyfob's remote start button is pressed and held down for greater than 4 seconds, it will send a vehicle turn off command to the IVU. The engine will be turned off and another message will be sent back to the keyfob causing three beeps (and LED flashes). The operator then knows that the vehicle has been successfully turned off.

Pseudorandom Frequency Hopping Sequence: Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirement specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1.

We use a Pseudo-Random hop table. The sequence was generated from a true random number set generator with values ranging from 0 to 49. After each transmit, the table index is incremented. The following is a simplification of what our software does:

```
uint8_t hop_table[50] = { 8, 24, 19, … 41 }; // Example hop table
uint8_t channel = 0;
```

…

```
void high_level_transmit (uint8_t *pData)
{
  low_level_transmit (hop_table[channel], pData);
  if (channel++ >= 50)
  {
    channel = 0;
  }
}
```

Equal Hopping Frequency Use: Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g., that each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event).

The software increments the hop index after every transmit. The transmit function uses the hop index to select the next hop channel from the pseudo-random hop table.

System Receiver Input Bandwidth: Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.

We used a software tool by the chip manufacturer which calculates the bandwidth settings. The SoC (Silicon Labs # Si1081) then uses these settings to set the bandwidth. These settings are the same for transmission and reception.

System Receiver Hopping Capability: Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals.

The receiver is a SoC containing a radio which features an automatic hopping feature. The hop table is programmed into the radio. The receiver starts at the base channel and hops in sequence from the top of the hop table to the bottom. The table will wrap around to the base channel once it reaches the end of the table. The receiver will scan for a preamble sequence for a preamble timeout period before hopping on to the next channel.