Maker Module –

Hawk Dryer Interface Definition

# Interface Modes:

The interface between the green bean and the dryer can take place while the appliance is in either a Consumer or a Native mode. These modes are defined as follows:

**Consumer Mode**: Allows programmers to access appliance high-level algorithms available to the consumer. In **Consumer Mode** a user connected with the green bean can request status or select cycles and features as if they were a user (or other function available via the front panel) but can not change the low level functions that govern how the cycle runs.

**Native Mode**: When a programmer uses the green bean to connect to the appliance in **native mode**: the API facilitates low-level, direct control of motors, fans, actuators, heaters, and other controlled devices.  High-level algorithms, such as a sensor dry and timed dry etc. are not operational.  Native mode allows programmers to, for example, create a new drying algorithm by controlling the loads in a desired manner.

# ⚠WARNING:

To prevent a risk of personal injury or property damage use this device and the API to modify the functionality of your GE Appliance only as directed in the Guide to Safe and Reliable Operation. While an appliance operates in Consumer Mode, the control software applies algorithms that help protect consumers from a risk of personal injury or property damage. However, in Native Mode, these algorithms are not active. Therefore you must follow all guidelines for Safe/Reliable Operation detailed below to prevent a risk of personal injury or property damage that can arise during Native Mode Operation.

## Guidelines for Safe/Reliable Native Mode Operation

1. Operation of Heaters and Drum Motor is prohibited with the door open. Hardware interlock exists that prevents operation unless door is closed but relays should not be driven prior to door being closed to prevent the door contact from switching the current.
2. Heaters should only be operated when drum is moving in a clockwise (CW) direction.
3. A hardware interlock (centrifugal switch) exists that blocks the heater operation unless the Drum motor is running. Drum motor should be running (CW direction) for a period of time to allow the centrifugal switch to close prior to turning on heaters. Likewise heaters should be turned off prior to stopping the drum motor and opening the centrifugal switch. This prevents centrifugal switch from switching current and increases overall reliability.
4. At the end of a cycle continue to rotate without heater operation for a period of time to reduce temperatures of clothing.
5. Do not operate the unit without appropriate oversight.
6. Valve operations should be time limited to prevent water damage.
7. To prevent dryer damage - Drum Motor Relay must be off for 6 seconds before changing directions and reenergizing the relay in order to allow drum to come to a complete stop prior to changing direction.
8. Mode Refresh – The Native mode must be refreshed with a new Native Mode Command (0x90) at least one time every 5 minutes (2.5 minute periodic rate is recommended).
9. Excessive relay cycling may lead to relay faults. Do not cycle relays more than once per minute.
10. Only documented commands should be used. All other commands are reserved for future use. As such, experimentation with these commands may negatively affect the performance of the unit in future software versions if used incorrectly.

# Objective:

This documentation is intended to serve as basic instructions for a user interfacing to a Hawk Dyer. The software version that was referenced for generation of this document is 1.45. The maker module documentation related to the interfacing to a specific appliance should focus on the following areas:

1. Interaction Guidelines – guidelines for using the maker module with GE Appliances including:
   1. Consumer Mode Interactions – details how to use the product with the currently supported modes to add functionality.
   2. Native Mode Interactions – Details how to use the Native mode to design custom algorithms to add additional functionality to the unit.
2. Command Set – A detailed list of the commands that can be used to interface to the appliance in Consumer and Native modes.

# Interaction Guidelines:

Interaction between an external application and the Dryer via communication will take place in either a Consumer Mode or in a Native mode. The mode choice depends upon the degree of control required. If a user want to extend the existing user interface to more easily control and monitor the behaviors of the dryer that already exist, then consumer mode interaction is sufficient. However, if different control algorithms are desired, then the Native Mode of the control can be used.

## Consumer Mode Interaction:

In the consumer mode it is possible to monitor status and control settings that are normally adjusted via the UI boards on the unit. An application could be written that either simplifies the user interface or extends the basic functionality of a unit using existing adjustments.

One specific example might be to extend the ability to communicate the machine status and specifically the end of cycle status to a phone or some other connected device.

An application written to support this feature would:

1. Setup to communicate the device via text or similar mechanism – ultimately this status would be posted for user display – media examples could be a TV or smart phone.
2. In order to become aware that a cycle is complete…. The application can monitor the status using ERDs. The application would want to subscribe to any change in the end of cycle status, but may also poll a number of ERDs to monitor and communicate status periodically.
   1. Subscribe to ERD 0x2002 in order to receive an alert regarding End of Cycle
   2. Poll the following ERD’s every minute. Note Multiple ERDs can be polled in one query.
      1. End of Cycle – 0x2002
      2. Cycle Time Remaining - 0x2007
      3. Machine Sub Cycle – 0x2001
   3. After ERD’s responses are received the application can do any or all of the following:
      1. Count down the time remaining
      2. Alert user when dryer enters a specific phase so user can respond accordingly
         1. Damp -- May wish to remove some garments when the Damp alert threshold is hit
         2. Cool Down – may wish to remove some garments immediately when the cool down is entered.
         3. End of Cycle - clothes are done time to remove what is left.

The benefit of remaining in consumer mode is that the control is always monitoring the performance and reliable operation of the appliance while still giving the technical user a chance to tailor the User Experience.

## Native Mode Interaction:

In a Native Mode the user/programmer can take a more active role in the control of the unit. However, the reliability and the performance is the responsibility of the programmer and their algorithms. The user is capable of individually controlling loads but as a result of this control they are responsible for following the **Guidelines for Safe/Reliable Native Mode Operation.**

### Example using Native Mode:

**Objective:** Use the load control commands to have an additional user indicator that a load is complete. The user can build on the earlier consumer mode application. After an end of cycle has been detected and for a specific time period (say 4 hours) or until the door opens the application would be used to periodically cycle the drum light (5 minutes out of every 30 minutes) to alert users that load is done.

#### Pseudo code Implementation:

1. External application would sense that the End of Cycle has been reached. See example in consumer mode monitoring the end of cycle ERD. Following that step 2 is executed.
2. Initialize state machine…and variables
   1. Supplemental Indicator state variable to Idle.
   2. Time In State Variable = 0 seconds
3. Enter loop to monitor door activity.
   1. Poll the door status
      1. Issue “Sensor Data Query” (0x33) – paying attention to byte [8] bit 0 of the response related to the door status.
   2. If the Door status indicates that the door is open Or the total time the state machine has been running exceeds the overall limit (say 4 hours) then
      1. Exit Native Mode – Issue “Enter/Exit Native Mode” (0x90) with a 0 to exit
      2. **Exit the loop – and end application**
   3. Else – Run Supplemental Indicator state machine (initial state should be idle)
      1. Idle state – time terminated state runs for 25 minutes. During this time the dryer is in the consumer mode.
         1. If time in state is >= 25 minutes
            1. Enter Native Mode - Issue “Enter/Exit Native Mode” (0x90) with a 1 to enter Native Mode.
            2. Reset time in state to 0 seconds
            3. Set Supplemental Indicator state variable to “Indication state”
            4. Restart Loop.
         2. Else (optional) to be certain we are really out of Native Mode application may send the Exit Native Mode command every minute.
            1. Issue “Enter/Exit Native Mode” (0x90) with a 0 to exit Native Mode. Note unit will reset each time this command is sent.
      2. Indication state – during this state (which operates for 5 minutes) the drum light is flashed 5 seconds on/off to alert the user that the cycle was finished.
         1. If time in state exceeds 5 minutes or more then
            1. Exit Native Mode -- this will reset the unit.

Issue “Enter/Exit Native Mode” (0x90) with a 0 to exit Native Mode.

* + - * 1. Reset the time in state variable to 0
        2. Set Supplemental Indicator state variable to “Idle state”
        3. Restart the loop
      1. Else
         1. if time in state is a multiple of 5 seconds or 0 then:

Toggle desired light state… On or off

Send load control command to control drum light according to desired state. This will also refresh the Native Mode state we will retain Native Mode.

Issue “Native Mode Load Control Command” 0x91 with the load control bytes set to turn drum light on or off see byte [4] all other bytes [0-3] should be 0.

* 1. Application delay for 0.25 seconds here – so execution loop is every ¼ second –
  2. Accumulate time counter – and go back to start of loop.
     1. Use Time counter to increment the time in state variable each second or assume a call rate through the entire loop (0.25 seconds to increment the time in state variable).
     2. Note incremented at the end intentionally since on state transitions we actually restart the loop when we set the time in state to 0 instead of going through this code.

1. End Application if door is or was open at any time after EOC was detected.

# Command Set:

Each command will be listed in general terms. For each command it is important that the user understand the destination address, the command itself (whether it is single or multi-byte), and the additional data that is sent with the command.

Destination Addresses when dealing with for the Dryer device is 0x24.

When a command is transmitted it is sent along with the source address. Source address is only discussed in the command set if it is relevant to the command logic. The “Data” area of the command below will generally be talking about what is added after the basic command.

The command set is as follows:

1. Read Software Version – can be directed to any of the board addresses noted above.
   1. Purpose: Query response to the control to determine current version of the application software.
   2. Command: 0x01
   3. Data sent with command (beyond source address and command): NA
   4. Minimum Response: Current Software major and minor versions. The software version is maintained as AA.BB.CC.DD where each AA-DD are just ## values appears within the range of 00 – 99. The data within the response is represented as a binary/hex value e.g. 99 = 0x63. Note depending upon which board is queried for the version command more data may be returned. In this application the response is:
      1. [0] = Critical Major Software Version
      2. [1] = Critical Minor Software Version
      3. [2] = Non-Critical Major Software Version
      4. [3] = Non-Critical Minor Software Version
      5. [4] = Parametric Major Version
      6. [5] = Parametric Minor Version
      7. [6] = Diagnostics Major Version
      8. [7] = Diagnostics Minor Version
      9. [8] = Current Model setting
      10. [9] = current Model Type
2. Sensor Data Query
   1. Purpose: Query for current sensor value readings.
   2. Command: 0x33
   3. Data sent with command (beyond source address and command): NA
   4. Response: Data related to the current reading of input sensors:
      1. [0-1] = U16 Raw Moisture Sensor Value
      2. [2-3] = U16 Averaged Moisture Sensor Value
      3. [4-5] = U16 Average Inlet Thermistor Temperature Degrees F
      4. [6-7] = U16 Average Outlet Thermistor Temperature Degrees F
      5. [8] = Bit encoded Load Status as follows:
         1. Bit 0 - Door Status
         2. Bit 1 - Drum Light
         3. Bit 2 - Centrifugal Switch
         4. Bit 3 - Inner Coil
         5. Bit 4 - Outer Coil
         6. Bit 5 - Drum Motor
         7. Bit 6 - Door Latch Status
         8. Bit 7 - Mist Valve
      6. [9] – Heater inhibit 0 – active/ Non-zero inhibited. Heaters may be inhibited due to algorithm conditions as well as drum direction.
3. Set Debug Log Status
   1. Purpose: Command used to activate or deactivate a streaming debug log.
   2. Command: 0x73
   3. Data sent with command (beyond source address and command): 1 byte to turn on (1) or off the debug log and a second byte that determines the interval in seconds. If the interval is set to 0 it is the equivalent of having the log off.
   4. Response: NA
4. Diagnostics Error Query
   1. Purpose: Query for information about a particular Error history stored for diagnostics purposes.
   2. Command: 0x82
   3. Data sent with command (beyond source address and command): 2 bytes to indicate which Error index and which page of that cycle data is being requested. Data split for a cycle potentially into multiple pages. Only one error page supported at time of this writing.
      1. [0] = Error buffer index
      2. [1] = Page number (only 0 for now)
   4. Response: Data related to unit history as follows:
      1. [0] - U8 Error Buffer Index –
      2. [1] - U8 Page Number (should be fixed at 0
      3. [2-3] - U16 Total Cycle Count - Total cycle count value at time error occurred.
      4. [4] – Relay states at time of error (bit mapped model specific)
      5. [5] – error type ID
      6. [6] – Appliance state at time of error where:
         1. 0 - Idle
         2. 1 - Standby
         3. 2 – Run
         4. 3 – pause
         5. 4 – End of Cycle
         6. 5 - DSM Delay
         7. 6 – Delay Run
         8. 7 – Delay Pause
      7. [7] – Base cycle number running when error occurred.
      8. [8] – primitive index when error occurred.
      9. [9-25] – Unused
5. Diagnostics Data Erase Command
   1. Purpose: Erase specific data form diagnostics record as part of repair/test process.
   2. Command: 0x83
   3. Data sent with command (beyond source address and command): 1 byte clarifying which data to erase. Choices are Erase all, Erase history in header only (unit run statistics), erase error and cycle diagnostics data (0/1/2 respectively).
   4. Response: NA
6. Native Mode Query Sampled Key States
   1. Purpose: Query, valid in Native Mode only, that is asking for a history of key presses since Native Mode was entered. Native Mode timeout is restarted when response is sent.
   2. Command: 0x86
   3. Data sent with command (beyond source address and command): NA
   4. Response: 4 byte bit encoded array that has bits cleared to indicate a key press associated with that bit position was observed. Mapping of bit location to keys is model dependent.
      1. [0 – 3] – Each byte has bits mapped to individual key presses.
7. Native Mode Query Sampled Encoder States
   1. Purpose: Query, valid in Native Mode only, that is asking which encoder positions have been sampled. Command is intended to prove that all encoder positions were read appropriately during production. The test would be to enter Native Mode and then have an operator turn the knob so that each position of the encoder is sampled. Native Mode timeout is reset when response is sent.
   2. Command: 0x87
   3. Data sent with command (beyond source address and command): NA
   4. Response: 2 byte quantity where each bit corresponds to an encoder position. Bit is cleared if the encoder was sampled at that position and set otherwise.
      1. [0 – 1] – Each byte has bits mapped to individual encoder positions.
8. Native Mode Erase Faults
   1. Purpose: Command issued clear all of the active faults in the unit. Fault data will be populated if fault is still present or repeats.
   2. Command: 0x89
   3. Data sent with command (beyond source address and command): NA
   4. Response: NA
9. Error History Query
   1. Purpose: Query for count for 13 different error codes that may have occurred at one time in the system.
   2. Command: 0x8A
   3. Data sent with command (beyond source address and command): NA
   4. Response: Error code 1 – 13 and the counts associated with each error. The data comes in 2 byte pairs where the first byte is the error code and the second byte is the number of times that error code was found in the fault buffer.
      1. [0], [1] = Error Code 1, Count for Error code 1
      2. …
      3. [24], [25] = Error Code 13, Count for Error code 13
10. Enter/Exit Native Mode.
    1. Purpose: Command used to enter or exit the Native mode.
    2. Command: 0x90
    3. Data sent with command (beyond source address and command): 1 byte indicating whether to enter (1) or exit (0) EOL mode. Unit resets on exit.
    4. Response: NA
11. Native Mode Load Control Command
    1. Purpose: Command used to enter or exit the Native Mode.
    2. Command: 0x91
    3. Data sent with command (beyond source address and command): 5 bytes associated with various loads as follows:
       1. [0] – Drum Rotation – CW/CCW/None – 2/1/0
       2. [1] – Heater Inner Coil – On/Off – 1/0
       3. [2] – Heater Outer Coil – On/Off – 1/0
       4. [3] – Steam Valve - On/Off – 1/0
       5. [4] – Drum Light – On/Off – 1/0
    4. Response: NA
12. Input Status Data Query
    1. Purpose: Query for current status of inputs.
    2. Command: 0x92
    3. Data sent with command (beyond source address and command): NA
    4. Response: Data related to the current reading of input sensors:
       1. [0-1] = "U16 Inlet Temperature (Deg F)
       2. [2-3] = "U16 Outlet Temperature (Deg F)
       3. [4-5] = "U16 Moisture Sensor Volts x100"
       4. [6] = "U8 Door Status 0 – Open 1 - Closed"
       5. [7] = "U8 Door Latch 1 – Clear 2 - Set"
       6. [8] = "U8 Centrifugal Switch 0 – Open 1 - Closed"
13. Native Mode Write LED Status
    1. Purpose: Command issued during Native Mode to control the status of the LEDs on the UI front panel.
    2. Command: 0x93
    3. Data sent with command (beyond source address and command): 14 bytes where each bit is coded to an individual LED. To turn on an LED the bit is set to turn off the LED the bit is cleared. Not all bit positions are mapped. Mapping is by Model.
    4. Response: NA
14. Encoder Position Query
    1. Purpose: Query for current position of the encoder 0 – 15 (0x0F).
    2. Command: 0x94
    3. Data sent with command (beyond source address and command): NA
    4. Response: Data related to the current reading of input sensors:
       1. [0] = Encoder Position 0-15 (0x0F)
15. Switch Status Query
    1. Purpose: Query for current position of up to 32 input switches (keys).
    2. Command: 0x95
    3. Data sent with command (beyond source address and command): NA
    4. Response: Bit encoded status for input keys indicating pressed (1) or released.
       1. [0-3] = Bits correspond to keys. Mapping depends upon model.
16. Native Mode Buzzer Control Command
    1. Purpose: Command issued during EOL mode to sound the Buzzer.
    2. Command: 0x96
    3. Data sent with command (beyond source address and command): parameters related to the buzzer frequency, and volume.
       1. [0,1] = Buzzer frequency in Hz
       2. [2] = Volume (0 – 100%)
       3. [3] = On/Off
    4. Response: NA
17. Error Status Query
    1. Purpose: Query for the status of various errors in the system.
    2. Command: 0x9A
    3. Data sent with command (beyond source address and command): NA
    4. Response: 4 bytes of bit encoded data where bits set correspond to error present and cleared is error absent. Not all are used at this time.
       1. [0] = Bits encoded as follows:
          1. 0 – Inlet Thermistor Short
          2. 1 – Outlet Thermistor Short
          3. 2 – Inlet Thermistor Open
          4. 3 – Outlet Thermistor Open
          5. 4 - EEPROM
          6. 5 - Stuck Button
          7. 6 – AC Input miswired
          8. 7 – Door Latch Stuck
       2. [1] = Bits encoded as follows:
          1. 0 – Drum motor
          2. 1 – UI Flash CRC error
          3. 2 – Watchdog reset
          4. 3 – UI Assert
          5. 4 – Door Signal stuck
          6. 5-7 unused.
       3. [2-3] – reserved for future use.
18. Model/Heater Type Query
    1. Purpose: Query for current model personality (0-15) and type of unit (Gas/Electric).
    2. Command: 0x9D
    3. Data sent with command (beyond source address and command): NA
    4. Response: Data related to the current reading of input sensors:
       1. [0] = Model Number
       2. [1] = Gas/Electric 1/0
19. Diagnostics Header Query
    1. Purpose: Query for aggregated diagnostics information related to general unit operation.
    2. Command: 0x9E
    3. Data sent with command (beyond source address and command): NA
    4. Response: Data related to unit history as follows:
       1. [0-3] - U32 Total Cycle Time (mins)
       2. [4-5] - U16 Total Cycle Count - Total cycles run over the life of the unit. Should be updated at the start of every cycle.
       3. [6-7] - U16 Total Error Count - Total dryer errors recorded over the life of the unit. Should be updated every time an error occurs.
       4. [8-11] - U32 Error History - One bit for each error. Bit will be set if the error is ever present in the machine. Error mapping is model dependent.
       5. [12] - U8 Cycle Storage Limit - Total size of the cycle buffer
       6. [13] - U8 Error Storage Limit - Total size of the error data buffer.
       7. [14] - U8 Cycle Pages Supported - Total number of cycle data pages that diagnostics supports
       8. [15] - U8 Error Pages Supported - Total number of error pages that diagnostics supports
20. Diagnostics Cycle Query
    1. Purpose: Query for information about a particular cycle stored for diagnostics purposes.
    2. Command: 0x9F
    3. Data sent with command (beyond source address and command): 2 bytes to indicate which cycle and which page of that cycle data is being requested. Data split for a cycle potentially into multiple pages.
       1. [0] = Cycle buffer index
       2. [1] = Page number
    4. Response: Data related to unit history depending upon the page number requested. (0-4) as follows:
       1. Common to all
          1. [0] - U8 Cycle Buffer Index –
          2. [1] - U8 Page Number - Cycle termination data"
       2. 0 = Cycle termination data
          1. [2-3] - U16 Total Cycle Count - Total cycle count value at cycle start
          2. [4-5] - U16 Cycle Data CRC
          3. [6] - U8 Cycle Completed
             1. 0 - Cycle did not complete
             2. 1 - Cycle completed (end of cycle state entered)"
          4. [7-25] – Unused
       3. 1 = Start of cycle user options
          1. [2-3] - U16 Total Cycle Count - Total cycle count value at cycle start
          2. [4-5] - U16 Delay Start Duration
          3. [6] - U8 Dryness Level
          4. [7] – Time Setting
          5. [8] – Temperature setting
          6. [9] – Signal level setting
          7. [10] – Selected Cycle
          8. [11] – E Dry setting
          9. [12] – Damp Alert Setting
          10. [13] – Control lock setting
          11. [14] - Extended tumble setting
          12. [15] – Detangle
          13. [16] – My Cycle selected
          14. [17] – Drum light
          15. [18-19] – U16 Estimated Cycle time Minutes
          16. [20-21] – U16 Target Moisture Sensor
          17. [22 – 25] Unused
       4. 2 = end of cycle user options
          1. [2-3] - U16 Total Cycle Count - Total cycle count value at cycle start
          2. [4-5] - U16 Delay Start Duration
          3. [6] - U8 Dryness Level
          4. [7] – Time Setting
          5. [8] – Temperature setting
          6. [9] – Signal level setting
          7. [10] – Selected Cycle
          8. [11] – E Dry setting
          9. [12] – Damp Alert Setting
          10. [13] – Control lock setting
          11. [14] - Extended tumble setting
          12. [15] – Detangle
          13. [16] – My Cycle selected
          14. [17] – Drum light
          15. [18-25] - Unused
       5. 3 = run data page 1
          1. [2-3] - U16 Total Cycle Count - Total cycle count value at cycle start
          2. [4-5] - U16 Actual Cycle Time in minutes
          3. [6-7] – Moisture Sensor after target reached
          4. [8-9] - Time to reach target voltage
          5. [10] – DOD multiplier
          6. [11] – DOD time adder
          7. [12] – DOD Temp multiplier
          8. [13] – Base Cycle Time before Target Voltage
          9. [14] – Base Cycle Time After Target Voltage
          10. [15] – load weight detected
          11. [16] – restriction detected
          12. [17] – door open count
          13. [18] – Pause key press count
          14. [19] – start key press count
          15. [20] – empty drum detected
          16. [21] – dry load detected
          17. [22] – door latch count
          18. [23 – 25] - Unused
       6. 4 = run data page 2
          1. [2-3] - U16 Total Cycle Count - Total cycle count value at cycle start
          2. [4-7] – Cycle Error HIstory
          3. [8 – 25] - Unused
21. ERD Query
    1. Purpose: Query for Entity Reference Designator (ERD) Data. This command is similar to a read. Requestor can ask for the data associated with 1 or more ERDs.
    2. Command: 0xF0
    3. Data sent with command (beyond source address and command): data that clarifies which ERDs are being queried.
       1. N - 1 byte representing the number of ERDs being requested
       2. N - 16- bit in big endian format that define the ERDs being requested.
    4. Response: The ERDs that were requested are returned assuming they fit in a transmittable data packet. The return format after the command and how many ERDs is noted is an array of ERDs and their associated data.
    5. Example Command: Example is a request for the Model number ERD.
       1. [0x80, 0x F0,0x01 0x00,0x01
    6. Example Response: Example is a request for the Model number ERD. The format of the response is the number of ERDs included in the response followed by the array of ERD data. Each ERD entry includes the 16- bit ERD number (in this example 0x0001), followed by a byte indicating the size of the ERD data (32 bytes in this example), followed by the data (not shown).
       1. [0x80, 0xF0, 0x01, 0x00, 0x01, 0x20,…]
22. ERD Write
    1. Purpose: Writing values to designated ERDs
    2. Command: 0xF1
    3. Data sent with command (beyond source address and command): N # of ERDs and N ERD structures (ERD #, size and data…). Everything in big endian
       1. N = 1 byte - # of ERDs that are being written
       2. N – ERD structures…
          1. 16- bit related to the ERD to write
          2. Y - 8-bit – size of ERD to write
          3. Y – bytes Data to be written
    4. Response: Return value includes a count of ERDs written and the list of ERDs that were written.
       1. N = 8- bit that represents the count
       2. N – 16-bit ERD #s that confirm the ERD was written.
23. ERD Subscribe
    1. Purpose: Gives ability for an entity to be alerted to the status of certain ERD’s either periodically or when the value changes.
    2. Command: 0xF2
    3. Data sent with command (beyond source address and command): The data included is the number of ERDs that are being subscribed to and a structure related to the subscription for each of those ERDs.
       1. N = # of ERDs that are being subscribed to.
       2. N- Structures related to the subscription including:
          1. 16- bit ERD #
          2. Byte – subscription time or 0 for alert on change. Note only alert on change is currently supported.
    4. Response: A count of the number of ERD’s that were subscribed to. Single byte
24. Request current Subscription List
    1. Purpose: Query to ask what the current subscription list is for a given device. List may be broken up into multiple messages if the list cannot fit within the context of 1 message.
    2. Command: 0xF3
    3. Data sent with command (beyond source address and command): NA
    4. Response: Similar to feedback on the write. Return value includes a count and list of how many ERDs are on subscription list.
       1. N = 8- bit quantity that represents the count
       2. N – 16-bit ERD #s that confirm the ERD was written.
25. ERD Unsubscribe
    1. Purpose: Remove 1 or more ERDs from the subscription list.
    2. Command: 0xF4
    3. Data sent with command (beyond source address and command): Number of ERDs and their identifiers that are to be removed from the subscription list.
       1. N = Number of ERDs to remove
       2. N- 16-bit ERD identifiers.
    4. Response: Simple acknowledgment that reflects the command only.
26. Subscribed ERD Update Notification
    1. Purpose: Virtually identical to the ERD Write command (0xF1), except the response is a simple confirmation packet. This is published by a node when subscribed ERDs have changed or the subscription periodic has expired.
    2. Command: 0xF5
    3. Data sent with command (beyond source address and command): see 0xF1 description
    4. Response: Packet level acknowledgement.
    5. Data sent with command (beyond source address and command): 1 Byte treated as a Boolean to indicate Degrees C or Degrees F when set to 1/0 respectively.
    6. Response: NA

A second aspect of the command set described above is the individual Entity Reference Designators (ERDs) that are supported within a given control. Each of these ERDs may maintain the ability to be read, written, or subscribed to so an external application can be alerted if the data value changes. See:

* Read = ERD Query 0xF0
* Write = ERD Write 0xF1
* Subscribe = ERD Subscribe 0xF2

Each ERD is characterized by its ERD ID, the length of data associated with the ERD, and an attribute that declares whether the ERD is Read Only. Within the appliance control, ERDs can be useful to control or monitor behaviors of the appliance in the consumer mode.

The following ERDs are supported on the Hawk Dryer:

1. ERD Name: Model Number
   1. Designator: 0x0001
   2. Data Size: 24
      1. Text characters….
   3. Read Only: True
2. ERD Name: Unit Serial Number (same information as 0xDD, 0x03, 0x04)
   1. Designator: 0x0002
   2. Data Size: 24
      1. Text characters
   3. Read Only: True
3. ERD Name: Machine Status
   1. Designator: 0x2000
   2. Data Size: 1
      1. 0 = Idle
      2. 1 = Standby
      3. 2 = Run
      4. 3 = Pause
      5. 4 = EOC
      6. 5 = DSMDelayRun
      7. 6 = DelayRun
      8. 7 = DelayPause
      9. 8 = DrainTimeout
      10. 9 to 127 = Not used
      11. 128 = Clean Speak
   3. Read Only: True
4. ERD Name: Machine Sub Cycle
   1. Designator: 0x2001
   2. Data Size: 1
      1. 0 = Not applicable
      2. 1 = Fill (washer only)
      3. 2 = Soak(washer only)
      4. 3 = Wash (washer only)
      5. 4 = Rinse(washer only)
      6. 5 = Spin(washer only)
      7. 6 = Drain(washer only)
      8. 7 = Extra Spin(washer only)
      9. 8 = Extra Rinse(washer only)
      10. 9 = Tumble (Dryer only)
      11. 10 = Load Size Detection (washer or dryer)
      12. 11 to 127 = Not used
      13. 128 = Drying (dryer)
      14. 129 = Mist Steam (dryer)
      15. 130 = Cool Down (dryer)
      16. 131 = Extended Tumble (dryer)
      17. 132 = Damp (dryer)
      18. 133 = Airfluff (dryer)
      19. 134 to 255 = Not used
   3. Read Only: True
5. ERD Name: End of Cycle
   1. Designator: 0x2002
   2. Data Size: 1 byte
      1. End of cycle active (1/0)
   3. Read Only: True
6. ERD Name: Cycle Count
   1. Designator: 0x2003
   2. Data Size: 2 bytes – U16 returned indicating the number of cycles unit has run.
   3. Read Only: True
7. ERD Name: Service Error Codes -
   1. Designator: 0x2004
   2. Data Size: 4 – each bit is mapped potentially to an error code. Bit is set if code is currently active.
      1. [0-1] – unused
      2. [2] – bit mapped as follows
         1. Bit 0 - Door Drum Motor
         2. Bit 1 - UI Flash CRC Error (washer only)
         3. Bit 2 - UI Watchdog Reset (washer only)
         4. Bit 3 - UI Assert (washer only)
         5. Bit 4 - 7 – Unused
      3. [3] – bit mapped as follows
         1. Bit 0 - Inlet Short
         2. Bit 1 - Outlet Short
         3. Bit 2 - Inlet Open
         4. Bit 3 - Outlet Open
         5. Bit 4 - Eeprom Error
         6. Bit 5 - Stuck Button
         7. Bit 6 - Door Switch Open
         8. Bit 7 - Door Brown Out
   3. Read Only: True
8. ERD Name: Demand Response Overrides Allowed
   1. Designator: 0x2005
   2. Data Size: 1
      1. Can User override DSM mode? 1/0.
   3. Read Only: False
9. ERD Name: Cycle Time Remaining (resolution seconds)
   1. Designator: 0x2007
   2. Data Size: 2 - U16 seconds remaining
   3. Read Only: True
10. ERD Name: Cycle Selected
    1. Designator: 0x200A
    2. Data Size: 1 byte (note coded for either washer or dryer)
       1. 0 = Not Defined
       2. 1 = Basket Clean
       3. 2 = Drain and Spin
       4. 3 = Quick Rinse
       5. 4 = Bulky Items
       6. 5 = Sanitize
       7. 6 = Towels /Sheets
       8. 7 = Steam Refresh
       9. 8 = Normal/Mixed load
       10. 9 = Whites
       11. 10 = Dark Colors
       12. 11 = Jeans
       13. 12 = Hand Wash
       14. 13 = Delicates
       15. 14 = Speed Wash
       16. 15 = Heavy Duty
       17. 16 = Allergen
       18. 17 = Power Clean
       19. 18 =Rinse & Spin
       20. 19 = Single Item Wash
       21. 20 to 127 = Not used
       22. 128 = Cottons
       23. 129 = Easy Care
       24. 130 = Active Wear
       25. 131 = Timed Dry
       26. 132 = DeWrinkle
       27. 133 = Quick/Air Fluff
       28. 134 = Steam Refresh
       29. 135 = Steam Dewrinkle
       30. 136 = Speed Dry
       31. 137 = Mixed
       32. 138 = Quick dry
       33. 139 =Casuals
       34. 140 = Warm up
    3. Read Only: True
11. ERD Name: Operating Mode
    1. Designator: 0x200E
    2. Data Size: 1 byte (not all modes valid)
       1. 0 = Consumer Mode
       2. 1 = Service Mode
       3. 2 = Native Mode
       4. 3 = Continuous Cycle/Evaluation Mode
       5. 4 - Rapid Relay Mode
       6. 5 = FCT Mode (EOL on M1 Laundry)
       7. 6 = Model Plug Entry Mode
       8. 7 = Demo Mode
       9. 8 = Consumer Error Mode
       10. 9 = Floor Type Selection Mode
    3. Read Only: True
12. ERD Name: Critical Response
    1. Designator: 0x200F
    2. Data Size: 1 byte – Critical response Enabled/Disabled (1/0) – related to Demand Side Management
    3. Read Only: False
13. ERD Name: Delay Time Remaining (resolution minutes)
    1. Designator: 0x2010
    2. Data Size: 2 bytes – minutes related in delay time.
    3. Read Only: True