Melody Smart v3.5.0
Manual Rev. A

Features

- Can run Standalone or with a Host Processor
- Configurable Bluetooth Low Energy (BLE) software
- Ability to be Central or Peripheral
- Transparent modes for Data or I2C commands
- Low power consumption: 10µA connected, 8µA idle
- Can be controlled over UART, BLE link or via AIO/PIO interfaces
- Connects to: iOS7+, Android 4.3+,Windows Phone 8.1+, Windows 8.1+, MacOS10.8+
- Profiles supported: Melody-Smart profile, Battery service, Device Info Service
- Highly flexible and configurable interface

Applications

- BLE sensors/ telemetry
- BLE sports devices
- BLE remote control and automation
- BLE data transfer

Description

Melody-Smart is an embedded firmware solution running on BlueCreation BC11x modules. It allows user control over the BC118 functionality over UART or BLE, full PIO control, bi-directional BLE data and command transfer. Melody-Smart is highly customisable and designed to enable fast development of BLE based products
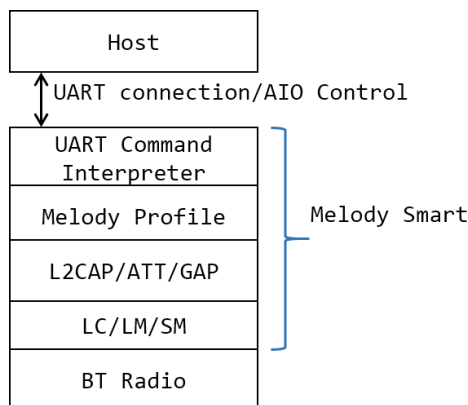
Block Diagram

Figure 1: Melody Smart block diagram

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Introduction

Melody-Smart is an embedded firmware solution running on the BC11x modules. Melody-Smart includes an application, the Bluetooth Low-Energy protocol stack, the Melody-Smart profile and the low level firmware. It therefore allows implementing a BLE device without any detailed knowledge of the Bluetooth standard. Melody-Smart provides a simple high level command interface where the Bluetooth module can be controlled from a host processor over UART or from an App over the Bluetooth Low Energy link (Over the Air commands). The remote device can control the BC118 module PIO pins.

Setting Up

To start you need to have:

a) BC118 Discovery Board.
    Please contact sales@bluecreation.com for more information.
b) A computer running a serial terminal, such as PuTTY, HyperTerminal for Windows or an equivalent program, to communicate over the COM interface.

The BC118 Discovery Board enumerates as a virtual COM port. Please use Device Manager to discover the port number.

By default, Melody Smart uses the following UART settings:

- Baud rate   :9600bps
- Data bits   : 8
- Stop bits   : 1
- Parity bit   : No parity
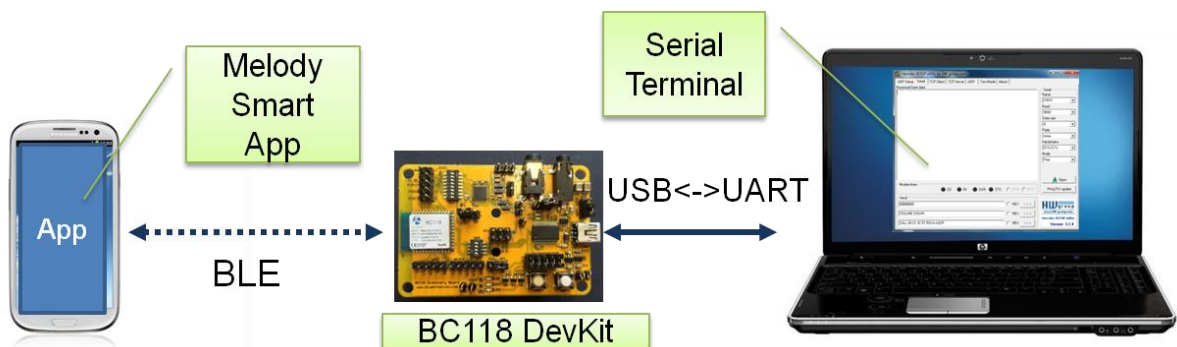- RTS/CTS Flow Control : Disabled

Figure 2: Example configuration

Once you have configured your serial terminal and opened the COM port, power up the development kit. You

should see a prompt appear on the screen of the terminal. If you see a prompt and a READY, the module is ready to operate.
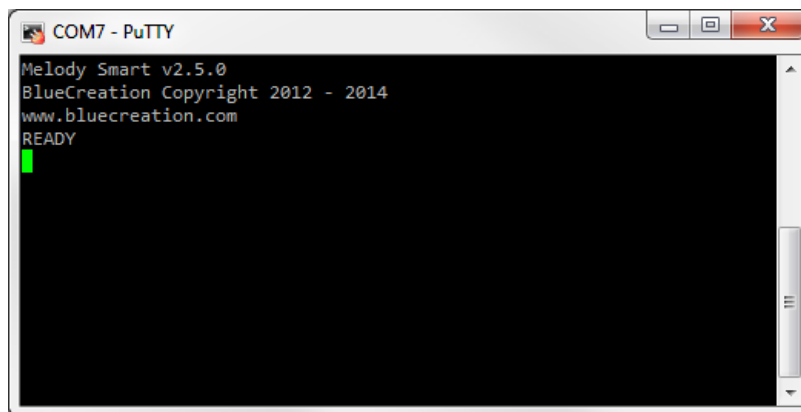

Figure 3: Melody Smart boot-up prompt

You are now ready to control the module!

If you do not see the prompt and READY appear, please check:

1) That the development is powered ON and receiving power
2) The UART settings on your serial terminal are the same as above
3) The FTDI Drivers are installed correctly
4) Check with your distributor that your module is loaded with Melody-Smart

UART Commands

When in Command mode, the module accepts commands from the host via the UART interface. The generic syntax for commands is:

`COMMAND (parameter_1) (parameter_2) … (parameter_n)\r`

with a space between each parameter and a carriage return ('`\r`' or `0x0D`) at the end of each command.

Melody will return an `'OK'` after each command to indicate that the command was executed. An `'ERR'` will be returned if the command has not been executed or if the parameters are wrong.

The different commands to control the Bluetooth link are listed in alphabetical order below. Mandatory parameters are listed in "`( )`" optional parameters are listed in "`[ ]`".

The different UART Commands to control the Bluetooth link are listed in alphabetical order below. The last two columns indicate if the command is available in Central (C), Peripheral (P) or both modes.

UART Command	Description	C	P
ADV (STATE)	(ON/OFF) disables or enables advertisements. Device needs to be in 'Idle' state to start advertising and in 'Advertising' state to stop. This command will return ERR if CCON=ON.	☒	☑
AIO (AIO)	Gets the voltage reading (mV) for the AIO. (AIO) can be 0,1,2.[1]	☑	☑
BAT	Shows battery level of the module. Returns the remaining battery power.	☑	☑
CMD (COMMAND STRING)	Send an OTA command to connected peripheral. The command string must be at most 20 characters long, including the '\r' character, and must be formatted as a normal UART command. This command will return Error if the command string is too long, or too short (minim length is 4); Error will also be sent if the remote device does not support OTA commands or if for some reason this device is unable to send OTA command at this time. If the command is sent successfully, there will be no OK reply, instead the remote device will return a response to the issued command. This will be displayed as the standard response for the command. The host needs to keep track of what commands it send locally and remotely and parse responses accordingly. Please note that there is no guaranteed timing or order in which responses will be received, so it is advisable that when issuing local and remote command, the host waits for a response before issuing another command. RCM ON needs to have been issued before issuing this command, otherwise ERROR will be returned.	☑	☒

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[1] Only available if ACFG=FALSE. Only voltages in the module Analogue domain can be detected.

CON [(BT ADDRESS) (TYPE)]	CON [(BT Address) (Type)] will initiate a connection to the specified address. (Type) must be 0 for public and 1 for private addresses. Both BT address and Type are returned by SCN function events. If using CON from idle or to a device that is not advertising, the device will enter a connecting state and try to connect to the supplied address indefinitely. STS will show state "CNG". Once the remote device becomes connectable, connection will be established immediately. To exit the connecting state, you can use the command DCN.	☑	☒
CFG	Displays all current configurations. See Table 2 for details.	☑	☑
CLR	Clears bonding. The command will return ERR if there is no bonding present.	☑	☑
DCN	Disconnects from current connected device (central and peripheral) or exit connecting state (central).	☑	☑
DMT	Puts the device into dormant mode. Dormant mode is the same state as hibernation (no connections and nothing is running). Dormant state can only be exitted when the Wake Pin is toggled to the WVLV specified level. DMT can only be used when Wake=ON and will return an ERROR if Wake=OFF.	☑	☑
HIB (TIMEOUT)	Places the module in Hibernate mode for a specific time. This clears the RAM and causes the module to do a clean reboot after the timeout expires or if the wake pin is toggled. (timeout) is between 1050 and 4294967295 and is in units of 1024µs. Note that the module is not guaranteed to wake up exactly after the specified timeout due to the time needed to boot the module. Note that toggling the wake pin can wake the module up before the timeout expires.	☑	☑
HLP	Displays available commands.	☑	☑
I2C (ADDR) (SIZE) [SIZE2]	This command is used to initiate an I2C command on the peripheral device remotely from the central device. ADDR is an 8 bit address with the R/W bit in the least significant bit position. The (SIZE) for reading and writing is limited to 19 bytes. The [SIZE2] parameter is optional and may only be supplied when in reading mode. It indicates that you wish to do a write followed by a restart condition and a read. The write may be of a maximum of 18 bytes. For writing: After parsing the command and checking the parameters, a return status will be returned for the command. If status is OK, Melody Smart will go into raw data mode, capture the next (SIZE) number of bytes coming from UART and transmit those over the air and exit raw data mode. For reading: After parsing the command and checking the parameters, a return status will be returned for the command. If status is OK. If [SIZE2] is present and nonzero, Melody Smart	☑	☒

	will go into raw data mode, capture the next **(SIZE2)** number of bytes coming from UART and transmit those over the air and exit raw data mode. When writing data, the raw data portion will take raw 8 bit values as received over UART. Note: Access to address 0xA0 is forbidden, as this is the address off the module boot media. Please ensure that any devices you connect do not have this address.		
GET (CONFIG)	Gets the current setting for configuration/s. See Table 2 for details.	☑	☑
LBD	List bonded devices. Only one device is supported at this time.	☑	☑
LCS (LICENCE KEY)	Enter the Melody Smart License key as 10 4 digit ASCII representations of hex digits. Eg. LCS 0000 1111 2222 3333 4444 5555 6666 7777 8888 9999	☑	☑
LPD [(PIO_3) (PIO_4) (PIO_10) (PIO_11)]	Display or set (if PIOM=OFF) local PIO direction. Setting a 1 for a PIO configures it as an output.	☑	☑
LPS [(PIO_3) (PIO_4) (PIO_10) (PIO_11)]	Display or set (if PIOM=OFF) local PIO direction. Setting a 1 for a PIO configures it as high, if it is an output.	☑	☑
RCM (STATE)	Enable (ON) Disable (OFF) Remote Command Mode. This needs to be called with ON to use the CMD command.	☑	☒
RST	Resets the module	☑	☑
RTR	Restores all configurations to default. RST is required to return the device in original state. No WRT command is required. See Table 2 for details on default configuration values.	☑	☑
SCN (STATE)	(ON/OFF) disables or enables scanning. Device needs to be in 'Idle' state to initiate scanning and in 'Scanning' state to stop it. This command will return ERR if CCON=ON.	☑	☒
SET (CONFIG)=(PARAMS)	Sets parameters for specified configuration. See Table 2 for details.	☑	☑
SND (DATA)	Sends data as raw data via notification on the Melody- Smart Data Characteristic. Note that data can currently be at most 20 bytes long. Data cannot contain '\r' (ASCII 0x0D) as this will be interpreted as the end of the command.	☑	☑
STS	Shows the device status in following format: STS =(MODE) (STATE) (Connected device) MODE can be C or P for central or peripheral. STATE can be INIT/ADV/SCN/CON/IDL for Initialising, advertising, scanning, connected or idle. The connected device Bluetooth address will be shown if there is an active connection.	☑	☑
TRS	Puts module into transparent UART mode immediately. Transparent mode is when all data going to the UART is sent to the remote device. To exit transparent, toggle SW1 on BC118 Discovery Board (PIO8), if GPIO control is enabled or reset module. Note: If the module is in transparent mode, this	☑	☑

	command sent over BLE can be used to exit the transparent mode.		
VER	Shows Melody-Smart version	☑	☑
WRT	Write all configuration parameters to NV memory. See UART Configuration Commands and Parameters	☑	☑

Table 1: UART commands

UART Configuration Commands and Parameters

When Melody is in Command mode, the user can configure general parameters for the module. These parameters are stored in the RAM memory. If required, the parameters can be stored to NV memory. When the module reboots, it will boot with the parameters that are saved to NV memory.

There are 4 main commands to configure parameters. The commands to modify configuration parameters are described below. Mandatory parameters are listed in "`( )`" optional parameters are listed in "`[ ]`".

All numerical values are integers and must be supplied in ASCII hexadecimal representation.

The configurations can be restored to defaults by holding PIO 8 high / keeping SW 1 pressed down while the Melody Smart boots, until the welcome prompt is seen.

Command	Description
`CFG`	Displays all current configurations and their settings. Same as GET without parameter. Note that if a configuration has been changed it will be shown here even if it is not stored.
`GET (CONFIG)`	Displays all current configurations and their settings or a specific configuration if specified. Note that if a configuration has been changed it will be shown here even if it is not stored.
`RTR`	Restores all configurations to default. RST is required to return the device in original state. No WRT command is required. This can also be done by holding PIO 8 during boot-up.
`SET (CONFIG)=(PARAMS)`	Sets a configuration with the supplied parameter or parameters. Please refer to Table 3 for details on available configurations and settings. Note that all configurations require WRT in order to be stored permanently; most require a RST to be applied.
`WRT`	Stores all configurations. These are then loaded at boot time.

Table 2: UART configuration commands

The different configuration parameters are described in alphabetical order in the table below. Once modified, many configuration parameters will not take effect before a reboot. Therefore they need to be stored to NV memory (WRT command) before rebooting. The configurations listed as not requiring a reset are applied in real time, but will be lost if the device is power cycled without a `WRT` command beforehand.

Configurations &Parameters	Description	Default	Requires reboot
`ACFG=(STATE)`	`STATE` can be ON or OFF. On enables AIO boot configuration and status reporting.	`OFF`	YES
`ACON=(STATE)`	`STATE` can be ON or OFF. On enables auto-connection to first Melody Smart enabled device while Scanning or to	`ON`	NO

Command	Description	Default	
	device with BT address set in ADDR (if bonding is disabled) (Central only)		
`ADDR=(BDADDR)`	Set BT address to connect to/ accept connections from when using auto-connection (ACON=ON). This only works for devices with public addresses and when bonding is disabled. If ADDR is set to all zeros this setting will be cleared and the central will connect to/accept connections from any Device that has the Melody Service.	`00000 00000 00`	YES
`ADVF=(MIN_PERIOD) (MAX PERIOD)`	Advertising parameters for fast mode. Minimum and Maximum advertising interval are supplied in ms. Currently Maximum value is used, but the firmware may use any value in between the two.	`003C 003C`	NO[2]
`ADVP=(RATE)`	SLOW or FAST advertisement rate.	`FAST`	NO[2]
`ADVS=(MIN_PERIOD) (MAX PERIOD)`	Advertising parameters for slow mode. Minimum and Maximum advertising interval are supplied in ms. Currently Maximum value is used, but the firmware may use any value in between the two.	`0500 0500`	NO[2]
`ADVT=(TIMEOUT)`	Timeout in seconds for advertisements; Only started if CCON=OFF; 0 means device will never stop advertising. Maximum value is 4260s (71mins).	`0000`	NO[2]
`BOND=(STATE)`	Enable/Disable bonding functionality. When Bonding is enabled, Melody will only stay connected to a device that supports bonding. Please see Bonding and Encryption for details.	`OFF`	YES
`CCON=(STATE)`	Enable/Disable constantly connectable mode. When enabled the device central/peripheral will always go scanning/advertising on start-up and disconnection. When disabled, on start up and disconnection the device will go into idle state.	`ON`	NO
`CENT=(STATE)`	`STATE` can be ON or OFF. On enables central mode.	`OFF`	YES
`CHAR=(UUID6) (UUID7)`	Change last 2 words of Melody Data Characteristic UUID.	`89F7 D93C`	YES
`CONP=(MIN_CONN_INTL) (MAX_CONN_INT) (LATENCY) (TIMEOUT)`	Set connection parameters to specified values.[3] This is only done on the peripheral side and if CONU=ON. Melody Smart Peripheral will request that the Central use these. If the exchange is successful a CONP= event will be received with the new connection parameters. Melody Smart Central will accept any valid connection	`000A 0010 0000 04E2`	NO[4]

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[2] Applied next time advertisements start.
[3] Please note that not all devices will accept all connection parameter values. Disconnection may be initiated by remote device if values are not accepted by remote device. The defaults supplied are tested to work against iPhone 4S and 5 running iOS 5.1.1 and newer.
[4] Applied on next connection.

	parameter s requested by the Peripheral and as such does not have preferred ones. Connection interval **max_conn_int** and **min_conn_int** values need to be between 6 and 3200, including. The max value has to be greater than or equal to the min values. The connection interval values are in 1.25ms units. Connection slave **latency** has to be a value between 0 and 499, including. This is in units of connection intervals. Slave latency must be a value in the range of 0 to $((\mathbf{timeout}/\mathbf{max\_conn\_int})-1)$ The supervision **timeout** needs to be a value between 10 and 3200. This is in units of 10ms. Connection parameters on connection will be shown using the CONP notification. These may be renegotiated at any point after that and the new parameters will be displayed using CONP again.		
CONU=(STATE)	Enable/Disable connection parameter update procedure on Slave/Peripheral side.	**ON**	NO[5]
FCTR=(STATE)	**STATE** can be ON or OFF. On enables RTS/CTS flow control for UART. If possible with the host, ON is recommended to avoid packet loss. Flow control is only actively used while the module is in transparent mode. Flow control CTS will always be asserted in non-transparent mode and RTS will not be observed.	**OFF**	YES
GPIO=(STATE)	**STATE** can be ON or OFF. On enables GPIO control and indications.	**ON**	NO
I2CE=(STATE)	Enable over the air access to I2C. On central this will enable the I2C command; on the peripheral this will accept central I2C action requests.	**ON**	YES
LEDS=(STATE)	**STATE** can be ON or OFF. On enables LED indications.	**ON**	NO
LNAME=(STATE)	Device full name. Maximum of 27 characters. No terminating "\0" required. This can be read by a connected central. By default this is BC followed by the last 5 characters of the device BT address.	**BCXXXXX**	YES
OTAC=(STATE)	Enable the device (peripheral only) to receive commands over the air.	**ON**	YES
OTAU=(STATE)	Enable OTAU support on the device.	**ON**	YES
PIOM=(STATE)	**STATE** can be ON or OFF. On enables PIO mirroring on	**OFF**	YES

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[5] Applied on next connection.

Command	Description	Default	
	Ports A and B		
RELA=(STATE)	Enable/Disable reliable sending of data when in transparent mode. If disabled, data will be discarded immediately after a send attempt, regardless off send status.	ON	NO
SCNA=(STATE)	Enable/Disable active scanning	OFF	YES
SCNP=(INTERVAL)(WINDOW)	Set scan interval and window, values accepted are between 2500 (0x0002BF2) and 10240000 (0x009C4000) microseconds, supplied in ASCII hexadecimal. Choosing smaller scan interval/larger window my result in too many scan response messages being sent over UART.	0002 BF20 0000 2BF2	YES
SCNT=(TIMEOUT)	Timeout in seconds for central connection attempts. 0 means device will never stop scanning. Maximum value is 4260s (decimal) (71mins).	0000	NO
SERV=(UUID6)(UUID7)	Change last 2 words of Melody Service UUID.	68E3 28F0	YES
SLEEP=(STATE)	**STATE** can be ON or OFF. Enables and disables Deep Sleep. Note that first character sent to UART will be lost when waking up from Deep Sleep. Enable the Wake pin and toggle it to the wake level before sending data to ensure module has woken up.	OFF	YES
SNAME=(STRING)	Device short name. Maximum of 7 characters. No terminating "\0" required. This will be included in the Advertising data. By default this is BC followed by the last 5 characters of the device BT address.	BCXXX XX	YES
TRSE=(STATE)	Enables transparent mode on next boot up. To exit transparent, toggle SW1 on the BC118 Discovery Board (PIO8), if GPIO control is enabled. Otherwise, reset module. If TRSM=ON, disconnection will exit transparent mode.	OFF	YES
TRSM=(STATE)	Set Automatic Transparent mode on connection: OFF – Go transparent after timeout ON – Go transparent on connection Note: TRS will invoke transparent mode immediately regardless of configuration.	OFF	NO
TRST=(TIMEOUT)	When TRSM=0, transparent mode will commence in TRST seconds. Value must be between 1 and 1800s.	0002	NO
TXPWR=(VALUE)	Set the transmit power. Valid values are 0 – 7. These are not dB values, but refer to module transmit power levels, 0 – lowest, 7 – highest. 0 corresponds to -20dBm, 4 – 0dBm, 7 – +7.5dBm coming out of the module. Please note that due to matching and antenna losses, actual TX radiated power will vary, but is generally	0007	NO

	approximately 1.5dB lower.		
`UART=(BAUD)`	Speed can be: 2K4 = 0x000A, 9K6 = 0x0028, 19K2 = 0x004E, 38K4 = 0x009E, 57K6 = 0x00EB. Takes hexadecimal value in format XXXX where X is a hexadecimal digit. To enable flow control, please use FCTR config.	`0028`	YES
`WAKE=(STATE)`	`STATE` can be ON or OFF. Enable or disable wake pin	`ON`	YES
`WLVL=(LEVEL)`	Set wake pin to wake module on high or low state.	`LOW`	YES
`WURX=(STATE)`	Configure module to wake form deep sleep on UART receive. Please note that this may corrupt the beginning of the data received. To ensure that data is received correctly it is best to assert the WAKE pin to the configured state, transmit over UART and dessert the WAKE pin.	`ON`	YES

Table 3: UART configurations and parameters

AIO Boot Time Configuration

If ACFG is enabled, the state of AIO 0 and 1 will determine module operational mode.

AIO pins operate in the 1.35V VDD_AUX domain for the BC118. Please ensure that your controls are in range.

AIO[6]	Description	Direction
AIO_0	Runtime override of CENT config; Logical high - boot the module in Central mode; Logical low - boot in Peripheral mode.	Input
AIO_1	Runtime override of TRSE config; Logical high - enable; Logical low - disable; If enabled the module will go into transparent mode as configured in TRSM.	Input

Table 4: If ACFG is enabled, on next boot, the module will be reconfigured based on AIO state

Note: These settings will override any stored configuration at runtime, but will not overwrite it.

AIO State Indication

AIO pins operate in the 1.35V VDD_AUX domain for the BC118.

Internal State	AIO2
Scanning	Logical low
Advertising	Logical low
Connected - Central	Logical high
Connected - Peripheral	Logical high
Idle	Logical low

Table 5: AIO state indication

LED State Indication

By default, the module has LED indications enabled on GPIO 4 and 9. LEDs are used to visually indicate module status based on table below.

State	LED pattern
Scanning	Flash Toggle LED 0
Advertising	Flash Toggle LED 1
Connected - Central	LED0 on , LED1 off
Connected - Peripheral	LED1 on , LED0 off
Idle	LED0 and LED1 on

Table 6: LED behaviour

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[6] Refer to BC118 Datasheet for location of PIO on the module PINOUT

GPIO Control and Signals

By default, the module can also be controlled by PIOs. This allows the module to work autonomously without the need of a host processor. The table below lists the UART commands that also have a PIO equivalent. This PIO functionality can be turned off (See UART Configuration Commands and Parameters).

GPIO[7]	UART Equivalent	Description	Direction
GPIO_8	NA	Exit Transparent mode.	Input
GPIO_3, GPIO_7	NA	GPIO Mirror PORT A	Configuration Dependent
GPIO_10, GPIO_11	NA	GPIO Mirror PORT B	Configuration Dependent
GPIO_4	NA	LED0	PWM Output
GPIO_9	NA	LED1	PWM Output
GPIO_5	NA	UART CTS	Output
GPIO_6	NA	UART RTS	Input

Table 7: GPIO Control and signals

UART PIO Connections

Signal	PIO	Direction
Tx	0	Output
Rx	1	Input
CTS[8]	5	Output
RTS[8]	6	Input

Table 8: 2- and 4- wire UART PIO connections

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[7] Refer to BC118 Datasheet for location of PIO on the module PINOUT
[8] Available if FCTR=ON

Melody Smart Prompts

In Command Mode, Melody-Smart uses 'prompts', to notify the host of events in the Bluetooth link (access requests, connection, pairing information, etc) , the module's PIOs and interfaces (change in PIO states or external interrupts), to provide information, or require action.

The range and availability of prompts is fully customizable based on customer specifications.

Prompt	Description

`Melody Smart vM.N.P`
 	
`BlueCreation Copyright 2012 – 2015`
 	
`www.bluecreation.com`
 	
`READY`
	Start-up prompt.
	M marks major version, currently 3; **N** marks minor version; **P** marks patch version;

`BlueCreation Copyright 2012 – 2015`
 	
`www.bluecreation.com`
 	
`Melody Smart vM.N.P`
 	
`Build: YYYYMMDD_HHMMSS`
 	
`Bluetooth Address`
 	
`20FABBXXXXXX`
 	
`OK`
	Response to `VER` command.
	
	M marks major version, currently 3; **N** marks minor version, currently 0; **P** marks patch version, currently 0.
	
	YYYYMMDD_HHMMSS – build date, with year, month, day and hour, minute, second
	
	X – marks a hexadecimal digit from Bluetooth address.

`AIO=(AIO) (LVL)`	The current level (`lvl`) in mV for the requested AIO (`aio`).
`BAT=(LVL)`	Battery level (`lvl`) in percent calculated as follows: `lvl = (bat_voltage-1.8)*100/1.2` This is configured for a 3V CR32 cell battery. Voltage is sensed at the VBAT pin on the module.
`BOND=(STATUS)`	Status indicates Bonding attempt status: OK – Bonding has been successful ERR – Bonding has failed due to remote device rejecting pairing request WAIT – Establishing encryption with bonded device failed, we will wait for remote device to imitate encryption with old keys for 30s and then timeout and disconnect. TO – Bonding timeout expired, link not encrypted
`DSC=(STATUS)`	Status indicates disconnection reason. `CF` – The connection failed to be established fully `LCL` – A locally initiated disconnection has succeeded. `LL` – The connection closed due to link loss

	`RMT` – A remotely initiated disconnection has succeeded `SEC` – The connection was closed by the remote side for security reasons, either local side does not support required bonding, repeated bonding attempts are being made, or bonding keys are wrong. `XXXX` – 4 digit hexadecimal number, non-standard disconnection reason/ HCI error status. For the meaning of HCI error codes, please refer to Bluetooth Core v4.0, Volume 2, Part D, Section 1.3.
ENCR=(STATUS)	Encryption status: ON – encryption established OFF – encryption stopped ERR – encryption state change failed (enabling encryption failed)
ERR	Error when a command has not been executed or the parameters are not correct.
FLT=(FAULT)	Indicates a fault has occurred. This should not happen under normal circumstances. If the system encounters a fault it is best that it is reset by the host. The faults values will be used by BlueCreation do determine failure mode and cause.

FTRS=(FEATURES)	In central mode this lets the user know which features the remote device supports. Features are printed as a hexadecimal representation of a uint16 value that is a bitmask of the different characteristics supported by Melody Smart as follows:
	
	| x | x | x | x | x | x | x | e | d | x | x | x | c | b | x | a |
	Bitmask fields:
	    a) PIO Mirroring
	    b) Data Transfer
	    c) Flow Control for Data
	    d) I2C Commands
	    e) OTA Commands
	    x) Don't Care/Reserved
	e.g. If all of the above are present **FTRS=018D**

CON=(STATUS) (ADDR) (TYPE)	OK - Successful connection. (ADDR) is 48bit Bluetooth address of connected device and (TYPE) indicates address type (0 – Public, 1 – Random)
CONP=(INTERVAL) (LATENCY) (TIMEOUT)	Displays new connection parameters being used. This will happen either after a connection or after a connection parameter update procedure succeeds. Values are in ASCII hexadecimal.
I2C=(STATUS) [(SIZE) (RAW DATA)]	Returns status of I2C command. (STATUS) is 0000 for success and 0001 for failure. If you issued a read command and the read succeeded the following parameters are included: (SIZE) – ASCII representation of the size of bytes returned (RAW DATA) – size number of raw uint8 values read from remote device

	transmitted over UART
LBD=(BT ADDRESS)	Shows the BT address of the Bonded device
LDN=(STATE)	MelodySmart data characteristic enabled/disabled (Peripheral only)
OTAU	Indicates Melody Smart will reboot into OTAU mode immediately after this message. Please note that some junk may appear on UART during reboot process.
RCV=(STRING)	Displays raw data written to Melody-Smart Data characteristic.
LPD=(PIO_3) (PIO_7) (PIO_10) (PIO_11)	Response to an LPD query, shows the direction of the user configurable pins.
LPS=(PIO_3) (PIO_7) (PIO_10) (PIO_11)	Response to an LPS query, shows the state of the user configurable pins.
PAIR=(STATUS)	A pair request has been received and the following has occurred: OK – pairing allowed ERR – pairing disallowed due to device already being bonded
SCN=B (BT ADDRESS) **T (TYPE ADDRESS)** **R (RSSI)** **M (MELODY SMART ENABLED)** **[X (TX POWER)]** **[N (SHORT NAME)]** **[F (ADVERTISING FLAGS)]**	Returns Advertisement and Scan responses with the fields indicated by B, T, N, F, R, M flags which mark respectively Bluetooth address, Bluetooth address type, Short name, Advertisement flags, RSSI, and Melody Enabled. The formats are as follows: B – ASCII hexadecimal representation of BT address T – ASCII hexadecimal representation of BT address type (0 – Public, 1 – Random) M – ASCII Boolean representation indicating if remote device is Melody Smart enabled (0 – not Melody Smart enabled, 1 Melody Smart enabled) R – ASCII hexadecimal representation of signed 8 bit decimal RSSI value X – ASCII hexadecimal representation of signed 8 bit decimal representation of TX power N – ASCII representation of name F – ASCII hexadecimal representation of flags[9] e.g. `SCN=B 20FABB000001 T 0 R E3 M 1 N BC00001 F 6`
STS=(ROLE) (STATE) **[(ADDRESS) (TYPE)]**	STS =(MODE) (STATE) (Connected device) MODE can be C or P for central or peripheral. STATE can be INIT/ADV/SCN/CNG/CON/DISC/IDL for Initialising, advertising, scanning, connecting, connected, disconnecting or idle. The connected device Bluetooth address (ADDRESS) and address type (TYPE) will be shown if there is an active connection. In addition, if there is an active connection a CONP= prompt will be issues indicating active connection parameters before OK is issued indicating end if STS command return values.

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[9] Advertisement flags as described in the Bluetooth 4.0 Specification

TRS=(STATE)	Indicates if the device will be in or out of transparent mode after this notification. ON – in, OFF – out

Table 9: Melody prompts

Transparent Mode

When in transparent mode, Melody Smart will transparently forward data to and from UART over the air via a proprietary protocol.

Please enable UART flow control if you would like to use this functionality as it will improve the reliability of the link.

Also, please note that due to the nature of the BLE connection, transmission speeds are not symmetrical and sending data from a Peripheral is faster than sending data to a Peripheral.

Throughputs in Transparent mode are as follows:

Direction	UART baud	Throughput over the air[10]
Peripheral → Central	9600	7.5 Kbps/ 0.9 KBps
Central → Peripheral		3.9 Kbps/ 0.5 KBps
Peripheral → Central	38400	29.9 Kbps/ 3.7 KBps
Central → Peripheral		3.9 Kbps/ 0.5 KBps
Peripheral → Central	57600	43.4 Kbps/ 5.4KBps
Central → Peripheral		3.9 Kbps/ 0.5 KBps

Table 10: Transparent mode throughput[11]

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[10] 1Kb = 1024B; 1Kb = 1024b; 1KB = 8Kb
[11] Throughput values are averages obtained between 2 BC118 running Melody Smart 3.2.0, connected to a PC via UART, sending a large file over a few minutes, one direction only. The connection parameters are the defaults for Melody 3.2.0

Over the Air Command Mode

Melody Smart can be controlled and configured over the air through the Melody Smart application on the iTunes and Play stores and the BlueCreation MelodySmart libraries or starting from v3.4.0 from another Melody Smart device acting as Central.

Over the air command and configuration allows users to configure and control remote standalone devices without the need of a host processor.

Please note that commands are limited to 20 bytes with the trailing '\r' included.

Responses are also limited to 20 bytes/packet and also limited in the number of packets that can be sent one after the other. No extra buffering is provided for OTA responses, so any response that cannot go over the air quickly enough will be received truncated or with data missing.

It is therefore not advisable to issue commands that have long responses or output large amounts of data eg. CFG without a parameter.

Over the Air Command mode allows users to remotely disable transparent mode via the TRS command.

GPIO Mirroring

If GPIO mirroring is enabled on both devices, GPIOs to form two Port A (PIO 3 and 7) on each device will be mirrored on Port B (PIO 10 and 11) of the remote device. Port A is input, Port B is output.

Central		Direction	Peripheral	
Port A (input)	PIO 3	$\longrightarrow$	PIO 10	Port B (output)
	PIO 7	$\longrightarrow$	PIO 11	
Port B (output)	PIO 10	$\longleftarrow$	PIO 3	Port A (input)
	PIO 11	$\longleftarrow$	PIO 7	

Table 11: GPIO Mirroring Ports and direction of mirroring

Over the Air Updates (OTAU)

Starting from version 2.5.0, Melody Smart supports Over The Air Updates (OTAU). This allows for Melody Smart to be updated via a BLE enabled mobile phone.

BlueCreation constantly improves on Melody Smart and this is the easiest way to get the latest features and bug fixes.

 Performing an OTAU will reset all configurations to defaults for the new firmware.

Before you start:

1) Ensure your Melody Smart device is not battery powered or the battery is fully charged.

2) Ensure your phone is being charged or has a good battery level.

3) Ensure you have access to the internet

In order to perform OTAU, please follow these steps:

1) Download the Melody Smart app from iTunes or Play Store.

2) Restore your Melody to default configuration (RTR), store (WRT) and reset (RST)

3) Open the Melody Smart application, choose your device and connect.

4) Once the application is connected choose "Firmware Upgrade".

5) Select the firmware you would like to upgrade to. We suggest always using the latest, unless you have been instructed by BlueCreation otherwise.

6) The upgrade screen will show you your current firmware version and upgrade version.

7) Select "Update Melody Smart" - this will start the process. You will see "OTAU" on the Melody Smart UART.

8) You will be asked to pair your device, if you have not done so already. Accept.

9) The update image file will download from the BlueCreation website and the update process will begin.

10) The status bar will show how far along the update process you are.

11) Do not switch off either device, walk away with your phone or disable Bluetooth as this will cause the update process to fail.

12) Once the device completes the update, you will be notified of a disconnection. The device will restart and load the new firmware.

13) Go back using the back button to the device screen and reconnect to your device as needed.

OTAU Troubleshooting

Should the OTAU process fail at any point you will be notified.

At this point you should go back to the device screen on your application and look for "BCXXXXX" or "MelodySmart OT".

If you see "BCXXXXXX", please restart the process as described above.

If you see "MelodySmart OT" you will need to perform two consecutive OTAUs to revert your device to normal working condition.

Recovery steps:

1) Select "MelodySmart OT" and Connect.

2) Pair your device if requested.

3) Select "Upgrade Firmware"

4) Select the latest FW image

5) The image will be downloaded and the update will start immediately

6) You will be notified that the default Bluetooth Address and Trim will be used. This is OK.

7) When the update compiles, go back to device screen

8) Connect to your device which will now be displayed as "BC00001"

9) Perform a normal upgrade

10) You have now restored your factory Bluetooth address and Trim and upgraded to the latest firmware!

Power Measurements

All measurements made with Melody Smart configured to: SLEEP=ON, TRSE=ON, TRSM=1, WAKE=OFF.

UART disconnected to remove leakage, RX pin pulled high via a 5k6 resistor (resistor leakage current included in current measurement values).

For Send/Receive tests wired loopback used on UART interface connecting TX to RX pins on device measured.

Measurements performed using analogue integration across a 1Ω 1% resistor measured with an Agilent 5½ digit Digital Multimeter at 100mA precision.

Set Up	Idle [mA]	Fast Advertising[12] [mA]	Slow Advertising[12] [mA]	Scanning[13] [mA]	Connected Idle[14] [mA]	Connected Send+Recv[14] [mA]
Melody Smart Default[15]	0.008	0.478	0.043	4.650	0.430	0.500[16]
Lowest Power[17]	0.008	NA	0.032	0.100	0.010	0.045[18]

Table 12: Reference power measurements

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[12] Applicable to Melody Smart in Peripheral mode only
[13] Applicable to Melody Smart in Central mode only
[14] Please note that for the configurations tested, the values measured for Peripheral and Central identical. This may not be true based on specific connection parameters used.
[15] Measurements done using the default Melody Smart Advertisement, Connection and Scan parameters;
[16] Send and receive of 1 20 byte packet/s at 9600 baud UART.
[17] Measurements done using Melody Smart configured to: ADVP=2800 2800, SCNP=009C400 000009C4, CONP=0C80 0C80 0006 0C80.
[18] Send and receive of 1 20 byte packet/connection interval at 9600 baud UART.

Bonding and Encryption

Melody Smart allows to BLE devices that support bonding to bond and encrypt the connection. Bonding also ensures that the Melody Smart device will then only connect to a specific device unless the bonding is cleared.

Connection:

1) In Peripheral mode and with Bond=ON, the module will only accept Bonded connections and reject any connection that are not requiring Bonding. Otherwise, it will close the connection.

2) In Peripheral mode and with Bond=OFF, the module will reject Bonded connections.

3) In Central mode and with Bond=ON, the module will only accept to connect to Peripherals which supports Bonding. Otherwise, it will close the connection.

4) In Central mode and with Bond OFF, the module will initiate connection without Bonding. If the Peripheral requires Bonding, the central will disconnect.

Once Bonded:

1) In Peripheral mode, when the module is bonded, it will only accepts packets from the device it is bonded to. The module will be visible to everybody while advertising, but will ignore any connection attempts from non-bonded devices.

2) In Central mode, if the module is bonded to a device using public address, the module will only show scan results from the device it is bonded to. If the module is bonded to a device with a resolvable random address, scan results will show unfiltered results of all devices advertising in range.

The table below shows the results of 2 modules attempting to connect depending on BOND configuration.

BOND=		Result
Central	Peripheral	
OFF	OFF	Connection, no bonding, no link encryption.
ON	OFF	Connection, Central attempts to bond, Peripheral rejects bonding, Central disconnects.
OFF	ON	Connection, Central discovers that peripheral required bonding and disconnects.
ON	ON	Connection, Bonding is successful, Link is encrypted and devices.

Table 13: Bonding behaviour between two Melody Smart devices with different BOND configurations.

Deep Sleep and Power Saving

In order to reduce power consumption, Melody Smart allows the device to be configured to go into Deep Sleep, whenever possible. This is done with the SLEEP=ON configuration.

When in Deep Sleep, the module is ON, but in a low power state. It is able to respond to Bluetooth events, internal events, as well as external interrupts and internal timers. To do so, the module is automatically taken out of Deep Sleep mode and the processing is done quickly to go back to Sleep.

However, there are multiple factors that may prevent the module from going to the Deep Sleep state:

- Enabling the Wake pin (WAKE=ON) and asserting it to the Wake Level it has been configured will keep the module awake for the duration of the assertion, regardless of the SLEEP configuration.

- Enabling Wake on UART Rx (WURX=ON) will wake the module up every time an UART start condition is detected on the UART pin. Please note that since the normal idle state for UART is high, it is up to the host to keep that in the correct state and not allow it to float or go low, as this will be detected as a start condition and will wake the module up or prevent the module from sleeping.

  Please also note, that due to the time it takes for the module to fully wake up the first characters received over UART may be corrupted. BlueCreation suggest that to prevent that the Wake pin is asserted to wake the module up, and following a small delay transmission on UART is started.

- Additionally, PIO activity or keeping the PIO/#SPI pin asserted for SPI mode will also wake the module up. Large amounts of PIO activity may therefore reduce the time the modules spends sleeping or eliminate that altogether.

When considering power saving, Connection, Advertisement, and Scan parameters will strongly affect the power consumed by the device. Please modify those to fit your application requirements and power budget.

Raw I2C Mode

Melody Smart exposes a command Interface for I2C devices connected to the module. This allows users to remotely access any I2C peripherals. The I2C Interface operates at 400 kHz.

We have tried to make this interface as generic as possible, in order to support a maximum number of devices, but as the range of I2C devices is incredibly large we have not tested this against all.

I2C writes and reads of upto 19 bytes can be done is generic way in this format.

Please note that the BC118 boot medium at address 0xA0 is protected from access via this interface. Please ensure that any device you connect to the BC118 does not have the same address.

It is up to the user to format the I2C write according to their device data sheet to accomplish the desired task.

Examples:

1) To write the byte sequence 0x01, 0x02, 0x03, 0x04, 0x05, 0x06 starting from address 0x1234 on an Atmel EEPROM the following data is transferred over I2C (remote ACKs are omitted):

`Start A2 0x12 0x34 0x01 0x02 0x03 0x04 0x05 0x06 Stop`

In terms of commands (in Bold) on Melody Smart central this would be:

I2C A2 8\r
OK
0x01 0x02 0x03 0x04 0x05 0x06
OK

2) To start a read of 4 bytes on the same EEPROM from address 0x1234 on an Atmel EEPROM the following raw command may be used (local ACKs omitted, remote data in []):

`Start A2 0x12 0x34 ReStart A3 [byte1] [byte2] [byte3] [byte4] NACK Stop`

In terms of commands (in Bold) on Melody Smart central this would be:

I2C A2 4 2\r
OK
0x12 0x34
OK

3) If your EEPROM allows you, you could start a read of 4 bytes from the current device register address, whatever it may be at that point (usually this gets incremented after every operation, but check your datasheet) . The raw command may be used (local ACKs omitted, remote data in [])

`Start A3 [byte1] [byte2] [byte3] [byte4] NACK Stop`

In terms of commands (in Bold) on Melody Smart central this would be:

I2C A2 4\r
OK

Melody Smart Release Notes

- *Melody Smart 3.5.0*
  - *Updated manual to include information about "DISC" disconnecting state.*
  - *Added RELA configuration to enable disable reliable sending in transparent mode*
  - *Fixed issue with garbage data being left in transparent send queues after disconnection*
  - *Resolved issue with disconnection status reporting + improved reporting*

- *Melody Smart 3.4.1*
  - *Resolved issue with last byte being stuck in transparent mode for certain UART chunk sizes*
  - *Updated manual to include information about "CNG" connecting state.*

- *Melody Smart 3.4.0*
  - Added ability to send OTA commands from central (CMD) + responses
  - Added RCM command to enable/disable Remote Command Mode on the central (and allow/disallow CMD commands
  - Added prompt indicating features supported by remote device (FTRS) on central
  - PIO control/Mirroring functionality re-factored and simplified
    - Removed RPD, RPS, RPN commands and prompts - the ways to control remote PIO states are: PIO Mirroring and OTA Commands
    - Changed LPD and LPS commands to take 4 parameters, one for each PIO available, instead of a bitmask
    - Changed how PIO Mirroring works. It now requires both sides to have it enabled in order to work

- *Melody Smart 3.3.1*
  - Fixed issue causing certain configurations not to be stored correctly

- *Melody Smart 3.3.0*
  - Melody Smart Configuration parameters now shown in alphabetical order
  - CONP now accepted in format MIN MAX LATENCY TIMEOUT
  - Fixed issue with WAKE WLVL configs that was retrieving/storing the wrong value from NVM
  - Fixed issue with scanning when ADDR is supplied and CCON and ACON are off
  - Fixed issue causing the central to stall when entering transparent mode on connection with TRSE=ON and TRSM=ON
  - Fixed issue causing the central not to force bonding when configured to require it
  - Fixed issue with default scan parameters applied not matching expected value
  - Fixed central stall issue when peripheral stops flow control when in transparent mode

- *Melody Smart 3.2.2*
  - Fixed SCN and ADVT timeouts not being applied
  - Default TRST to 2s
  - Show connection parameters when connection parameter procedure fails due to remote side rejecting parameters

- *Melody Smart 3.2.1*
  - Fix in OTA command responses

- *Melody Smart 3.2.0*
    - Transparent mode: Central --> Peripheral reverted to old slow method due to known stall condition
    - Added Configuration Restore on boot: holding PIO8/SW1 high during boot (until welcome prompt is sent over UART) will restore settings to default and clear any previously stored settings
    - I2C interface made more general and I2C central command and notification re-worked to reflect that
    - I2C interface now returns an error when an attempt is made to access the boot media EEPROM over the air
    - STS prompt now includes connected device Bluetooth address type and connection parameters for active connection
    - CON=prompt now includes connected device Bluetooth address type
    - GET, SET, CFG, WRT commands now work if no licence is supplied; this allows the module to be configured and licence supplied using a single reset to apply license and configs.
    - Fixed issue with FCTR/TRSE config introduced in 3.1.0
    - Flow Control minor fixes and enhancements

- *Melody Smart 3.1.0 (beta only)*
    - Added I2C access to peripheral I2C bus over the air and enable config for that.
    - Added ability to issue Commands over the air to Peripheral devices and enable config for that and receive responses over the air.
    - Added OTAU enable/disable config
    - Changed TRSM config to Boolean On/Off to match internal representation and handling.
    - Added functionality for CON command: it can now be used when idle, to make the device enter a connecting state, attempting to establish a connection to the specified device
    - DCN now also causes devices to exit connecting state
    - Added DMT command to put device into dormant mode.
    - TRS command now toggles transparent mode. Exiting transparent with this command is only possible over the air.

- *Melody Smart 3.0.5*
    - Fixed issue causing Central device not to display received data from peripheral when not in transparent mode

- *Melody Smart 3.0.4*
    - Fixed issue causing device not to go into connectible mode after CLR for Central
    - Added persistent memory read/write retries
    - Fixed persistent memory write failure fault message mislabelling

- *Melody Smart 3.0.3*
    - Fixed issue causing device not to go into connectable mode after CLR for Peripheral
    - Fixed issue causing device not to start advertisements with ADV command after CLR
    - Changed ADV/SCN behaviour when CCON=ON - commands will now return ERR as device is set to always be connectable.
    - Manual: TXPWR values explained in more detail

- *Melody Smart 3.0.2*
  - o Fixed issue causing Melody Central to go Idle on Local disconnect even when CCON=ON

- *Melody Smart 3.0.1*
  - o Added BLE bonding support (BOND config, LBD, CLR commands, BOND, ENCR, PAIR, LBD prompts)
  - o Increased data throughput in Central→Peripheral direction
  - o DCN=OK prompt is deprecated
  - o Added more status codes for DCN= prompt indicating source of disconnection or reason
  - o When no/wrong licence is present only the LSC, VER, RST commands now work. Any other command will return ERR
  - o Added Scan type configuration SCNA
  - o Changes in auto connection to a supplied address (ACON=ON and ADDR is set) behaviour when bonding is enabled
  - o Added OTAU prompt to indicate when MelodySmart will reboot into OTAU mode.
  - o Constant connectable (CCON) config now applied on boot.
  - o Multiple internal improvements

- *Melody Smart 2.7.6*
  - o Added WURX configuration to enable/disable waking the module from Deep Sleep on UART Rx
  - o Added TXPWR configuration to set transmit power
  - o RTR now restores the config in RAM to defaults as well

- *Melody Smart 2.7.5*
  - o Fixed issue with connection update procedure
  - o Configuration will now be reset on every OTAU
  - o Melody Smart now allows the user to enter a license after the licence check fails
  - o Peripheral, indication to show remote side has enabled data notifications
  - o Fixed issue that was failing to stop advertisements on ADV OFF
  - o Removed Transparent Mode 2
  - o Added notification to indicate going into transparent mode
  - o Scan responses are re-formatted to include the mandatory fields first, followed by the optional at the end to ease parsing

- *Melody Smart 2.6.0*
  - o Added auto-connect ACON config
  - o Added SCN prompts to display scan/advertisement data received
  - o Changed SCN behaviour to not initiate connection unless in special cases (ACON=1 or ADDR is specified)
  - o CON function parameters have changed to include BD address type, and in special cases (idle, ACON=1 and no ADDR specified) calling this without parameters will initiate scanning and connection
  - o OTAU updated, some OTAU fail-safe's added
  - o PIO mirroring functionality configured for BC118

- *Melody Smart 2.5.0*
  - o Added UART RTS/CTS flow control

- o Added Transparent mode
- o Added AIO configuration
- o Added AIO state indication
- o Added configuration to automatically put device into advertisement state when not connected
- o Reconfigured to support BC118
- o GPIO control functionality revised and limited to exiting transparent mode.
- o Added Over The Air Update (OTAU)

- *Melody Smart 2.1*
    - o AIO read ability added
    - o Minor bug fixes

- *Melody Smart 2.0*
    - o Central functionality added
    - o GPIO mirroring added
    - o Connection parameter configuration added

- *Melody Smart 1.0*
    - o Initial release, peripheral only