



Migration Guide

HL78xx to HL7900/HL7900E

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Corporate and product information	Web: sierrawireless.com

Revision History

Revision Number	Release Date	Changes
1	June 2024	Document creation, preliminary release
1.1	July 2024	Minor edits and updates from internal review

Revision Number	Release Date	Changes
2	May 2025	<p>Removed AT+KCDRX, AT+KCARRIERCFG, AT+KCIOTOPT, and AT+KSRAT commands from Table 4-1</p> <p>Removed the following AT+CTZU, AT+CTZR, AT+CREG, AT+CEREG, AT+CGREG, AT+CNMI under the persistent list</p> <p>Updated Table 2-1: HL78xx and HL79 Series Approvals</p> <p>Updated 2.2 General Features Comparison: HL78xx Series vs HL7900</p> <p>Updated 3.1.1 HL78xx Series to HL7900 Pin Comparison</p> <p>Updated 3.1.2.1 Module Pin-outs</p> <p>Updated Table 3-1: C Pins—HL78xx Series vs. HL7900</p> <p>Updated Table 3-2: B Pins—HL78xx Series vs. HL7900</p> <p>Updated Table 3-5: HL781x, HL79 LPM Current Consumption - CAT-M</p> <p>Updated Table 3-6: HL781x, HL79 LPM Current Consumption - CAT-NB</p> <p>Updated Table 3-7: HL781x, HL79 Current Consumption - Connected Mode - Cat-M1</p> <p>Updated Table 3-8: HL781x, HL79 Current Consumption - Connected Mode - Cat-NB2</p> <p>Updated Table 3-9: Power On Timing Table</p> <p>Updated Table 3-10: WAKEUP Timing (from OFF Mode)</p> <p>Updated Table 3-11: WAKEUP Timing (from Lite Hibernate Mode)</p> <p>Updated Table 3-12: WAKEUP Timing (from Hibernate Mode)</p> <p>Added NB-NTN values for HL7810 and HL7812 in 2.1 General Features Comparison: HL78xx Series vs HL7900</p> <p>Updated C43 under Table 3-1: C Pins—HL78xx Series vs. HL7900</p> <p>Added NB-NTN values for HL7810 and HL7812 in Table 3-4: HL7800, HL7802, HL7810, HL7812, and HL7900 Supported Bands</p> <p>Other minor edits</p> <p>Updated Figure 4-1: Remote Debugging feature in the HL7900</p> <p>Added 4.2 PSRAM</p>
3	June 2025	Added 3.1.7 Power On Sequence
4	October 2025	<p>Updated Table 3-1: C Pins—HL78xx Series vs. HL7900</p> <p>Updated Table 3-3: HL7900 Module Pin Definitions</p> <p>Updated Table 3-5: HL781x, HL79 LPM Current Consumption - CAT-M</p> <p>Updated Table 3-6: HL781x, HL79 LPM Current Consumption - CAT-NB</p> <p>Updated Table 3-7: HL781x, HL79 Current Consumption - Connected Mode - Cat-M1</p> <p>Updated Table 3-8: HL781x, HL79 Current Consumption - Connected Mode - CAT-NB2</p> <p>Updated Table 3-10: WAKEUP Timing (from OFF Mode)</p>
5	December 2025	<p>Added 4.3 HL7900E Special Content</p> <p>Added HL7900E wherever applicable</p>
6	March 2026	Added 4.4 Manual Firmware Upgrade via LwM2M FOTA

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1: Introduction

This document provides guidance to customers working to migrate a design that uses an HL78xx module to use the Product Name.

1.1 Modules for Migration

Recommendations are provided to maximize compatibility between applications (customer boards) when using the Product Name.

The following table lists which HL modules can be migrated to a compatible Product Name module.

Table 1-1: HL780x to HL781x Series Compatibility

HL Module	Compatible HL Module
HL7800	Product Name
HL7802	
HL7810	
HL7812	

2: General Information

2.1 List of Approvals

The following table lists the regional carrier and regulatory approvals for the HL78xx and HL79 series modules. still

Table 2-1: HL78xx and HL79 Series Approvals

Compliance		HL7800	HL7802	HL7810	HL7812	Product Name
EU	CE	Y	Y	Y	Y	γ ^a
USA	FCC	Y	Y	Y	Y	γ ^a
Canada	IC	Y	Y	Y	Y	γ ^a
Japan	MIC	Y		Y	Y	γ ^a
South Korea	KCC	Y		Y		γ ^b
Taiwan	NCC	Y		Y	Y	γ ^a
Australia^c		Y	Y	Y	Y	γ ^a

- HL7900E module regulatory approval testing is still in progress.
- May be added in the future based on customer demand.
- Module is compliant with the applicable requirements from AS/CA S042.1:2022 and AS/CA S042.4:2022. Relevant supporting documentation will be provided to support RCM certification at end-device level.

2.2 General Features Comparison: HL78xx Series vs Product Name

The following table summarizes and compares key features between HL78xx series and Product Name modules.

	HL7800	HL7802	HL7810	HL7812	Product Name
Technology	<ul style="list-style-type: none"> ▪ M1: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 27, 28, 66 ▪ NB1: 1, 2, 3, 4, 5, 8, 12, 13, 17, 18, 19, 20, 25, 26, 28, 66 ▪ SIM/USIM support 	<ul style="list-style-type: none"> ▪ M1: 1, 2, 3, 4, 5, 8, 12, 13, 14, 18, 19, 20, 25, 26, 27, 28, 66 ▪ NB1: 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 66 ▪ 2G: GSM 850, E-GSM 900, DCS 1800, PCS 1900 ▪ SIM/USIM support 	<ul style="list-style-type: none"> ▪ M1: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 85 ▪ NB2: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 85 ▪ NB-NTN: 23, 255, 256 ▪ SIM/USIM support ▪ iSIM support^a 	<ul style="list-style-type: none"> ▪ M1: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 85 ▪ NB2: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 85 ▪ NB-NTN: 23, 255, 256 ▪ 2G: GSM 850, E-GSM 900, DCS 1800, PCS 1900 ▪ SIM/USIM support ▪ iSIM support^a 	<ul style="list-style-type: none"> ▪ M1: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66 ▪ NB2: 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 65, 66, 70, 85 ▪ NB-NTN: 23, 255, 256^{a,c} ▪ SIM/USIM support ▪ iSIM support^a
Protocol Stack	<ul style="list-style-type: none"> ▪ 2G (HL7802 only) ▪ GPRS Class 10 ▪ Cat-M1 3GPP Rel.13: Up to 1100 kbit/s UL, 590 kbit/s DL ▪ NB-IoT 3GPP Rel. 13: Up to 62 kbit/s UL, 26 kbit/s DL 		<ul style="list-style-type: none"> ▪ 2G (HL7812 only) ▪ GPRS Class 10 ▪ Cat-M1 3GPP Rel.14: Up to 1100 kbit/s UL, 590 kbit/s DL ▪ NB-IoT 3GPP Rel. 14: Up to 158 kbit/s UL, 127 kbit/s DL 		<ul style="list-style-type: none"> ▪ Cat-M1 3GPP Rel.14^b: Up to 1100 kbit/s UL, 590 kbit/s DL ▪ NB-IoT 3GPP Rel. 14^b: Up to 158 kbit/s UL, 127 kbit/s DL

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	HL7800	HL7802	HL7810	HL7812	Product Name
Interfaces	1x 8-wire UART	1x 8-wire UART	1x 8-wire UART	1x 8-wire UART	1x 8-wire UART
	1x 4-wire UART for Debug	1x 4-wire UART for Debug	1x 4-wire UART for Debug	1x 4-wire UART for Debug	1x 4-wire UART for Debug
	1x Active Low RESET	1x Active Low RESET	1x Active Low RESET	1x Active Low RESET	1x Active Low RESET
	1x USB 2.0	1x USB 2.0	1x USB 2.0	1x USB 2.0	-
	2x System Clock Out (32.768khz & 26Mhz)	2x System Clock Out (32.768khz & 26Mhz)	2x System Clock Out (32.768khz & 26Mhz)	2x System Clock Out (32.768khz & 26Mhz)	2x System Clock Out (32.768khz & 26Mhz)
	1x Active Low POWER-ON	1x Active Low POWER-ON	1x Active Low POWER-ON	1x Active Low POWER-ON	-
	1x 1.8V SIM	1x 1.8V SIM	1x 1.8V SIM	1x 1.8V SIM	1x 1.8V SIM
	-	-	-	-	1x JTAG Interface
	12x GPIOs	12x GPIOs	12x GPIOs	12x GPIOs	14 x GPIOs (ring C: 12 GPIOs, ring B: 2 GPIOs)
	1x Main Antenna	1x Main Antenna	1x Main Antenna	1x Main Antenna	1x Main Antenna
	1x GNSS Antenna	1x GNSS Antenna	1x GNSS Antenna	1x GNSS Antenna	1x GNSS Antenna ^c
	1x TX ON	1x TX ON	1x TX ON	1x TX ON	1x TX ON
	1x External PA Voltage Control Indicator	1x External PA Voltage Control Indicator	1x External PA Voltage Control Indicator	1x External PA Voltage Control Indicator	1x External PA Voltage Control Indicator
	1x VGPIO	1x VGPIO	1x VGPIO	1x VGPIO	1x VGPIO
	2x ADC	2x ADC	2x ADC	2x ADC	2x ADC
	1x Wake Up Signal	1x Wake Up Signal	1x Wake Up Signal	1x Wake Up Signal	2x Wake up signal
	-	-	-	-	1x External FLASH
	-	-	-	-	1x MIPI
	-	-	-	-	1x External PSRAM interface
-	-	-	-	1 x External Alarm	

	HL7800	HL7802	HL7810	HL7812	Product Name
Small Form Factor	18mm x 15mm x 2.4mm (nominal)				

- a. Future firmware upgrade
- b. Future firmware upgrade to Rel.15, 16, 17.
- c. For HL7900 only.

3: Hardware Migration

To maintain proper forward compatibility and offer additional hardware features, the following hardware guidelines are defined.

3.1 HL78xx Series to HL7900/HL7900E

3.1.1 HL78xx Series to HL7900/HL7900E Pin Comparison

Ring C pin definitions are the same between the HL780x, HL781x, and HL7900/HL7900E. The HL7900 also adds Ring B pins for new features. In an existing HL78xx design, the inner ring B can be left disconnected but there must be nothing on the PCB that will affect it.

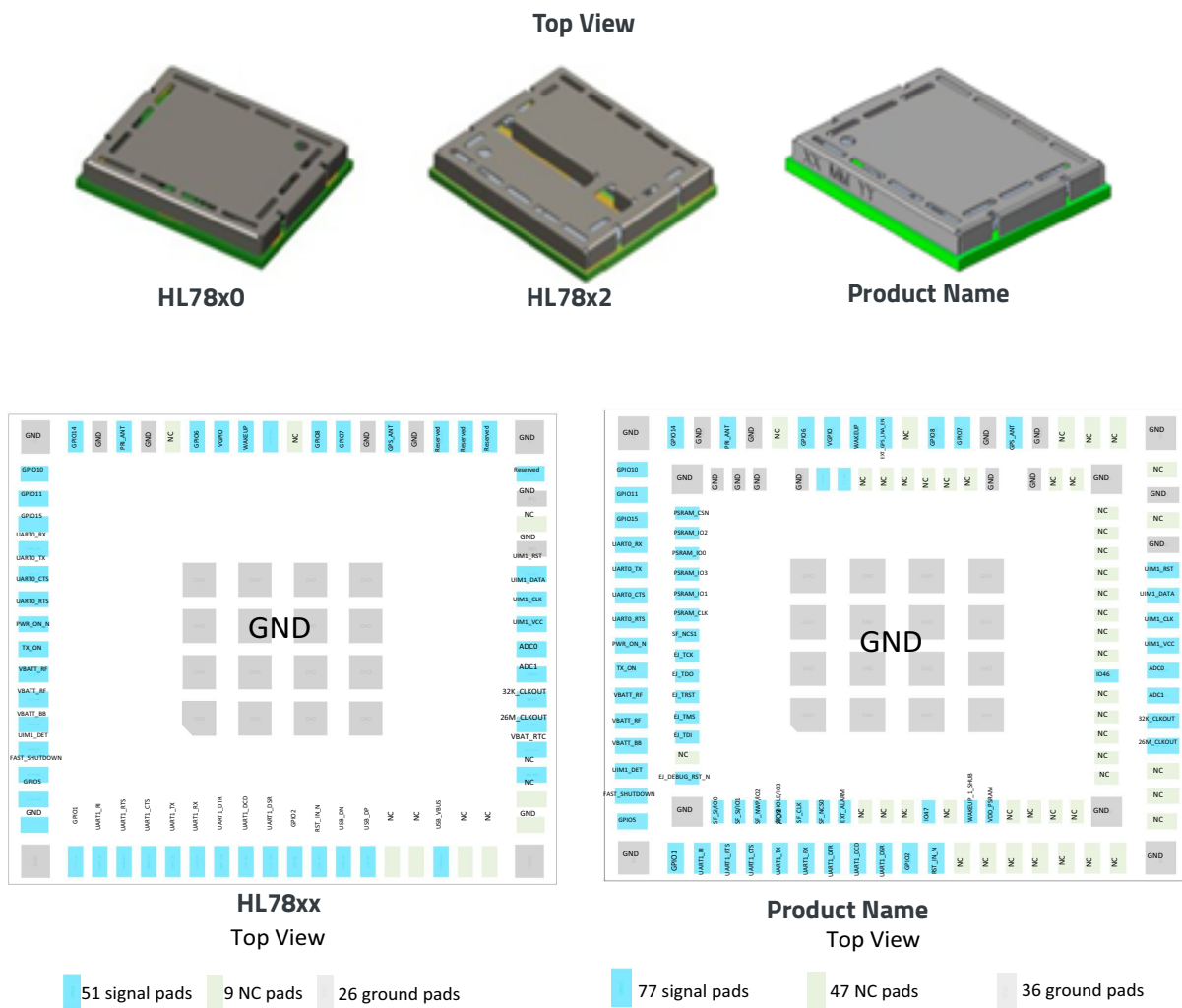


Figure 3-1: HL78xx vs HL7900 Series pins

3.1.2 Pin Comparison

The following tables indicate all the available pins, with their corresponding signal names and function, in the HL78xx series modules and the Product Name module.

[Table 3-1](#) indicates and highlights the functional differences between the ring C pins of the HL78xx series modules versus the Product Name module. [Table 3-2](#) indicates all the ring B pins added in the Product Name module.

Table 3-1: C Pins—HL78xx Series vs. Product Name

Pin #	Signal Name	HL78xx Function	Product Name Function
C1	GPIO1	General purpose input/output	General purpose input/output
C2	UART1_RI	UART1 Ring Indicator	UART1 Ring Indicator
C3	UART1_RTS	UART1 Request To Send	UART1 Request To Send
C4	UART1_CTS	UART1 Clear To Send	UART1 Clear To Send
C5	UART1_TX	UART1 Transmit Data	UART1 Transmit Data
C6	UART1_RX	UART1 Receive Data	UART1 Receive Data <i>Note: It is recommended to design an external pull-up resistor circuit.</i>
C7	UART1_DTR	UART1 Data Terminal Ready	UART1 Data Terminal Ready
C8	UART1_DCD	UART1 Data Carrier Detect	UART1 Data Carrier Detect
C9	UART1_DSR	UART1 Data Set Ready	UART1 Data Set Ready
C10	GPIO2	General purpose input/output	General purpose input/output
C11	RESET_IN_N	Input reset signal	Input reset signal
C12	USB_D-	USB Data Negative (Full Speed)	Not Connected
C13	USB_D+	USB Data Positive (Full Speed)	Not Connected
C14-C15	NC	Not Connected	Not Connected
C16	USB_VBUS	USB_VBUS	Not Connected

Table 3-1: C Pins—HL78xx Series vs. Product Name (Continued)

C17-C20	NC	Not Connected	Not Connected
C21	NC	NC	Not Connected
C22	26M_CLKOUT	26 MHz System Clock Output	26 MHz System Clock Output
C23	32K_CLKOUT	32.768 kHz System Clock Output	32.768 kHz System Clock Output
C24	ADC1	Analog to digital converter	Analog to digital converter
C25	ADCO	Analog to digital converter	Analog to digital converter
C26	UIM1_VCC	USIM1 Power supply	USIM1 Power supply
C27	UIM1_CLK	USIM1 Clock	USIM1 Clock
C28	UIM1_DATA	USIM1 Data	USIM1 Data
C29	UIM1_RESET	USIM1 Reset	USIM1 Reset
C30	RF_DIV_GND_1	Ground	Ground
C31	NC	Not Connected	Not Connected
C32	RF_DIV_GND_2	Ground	Ground
C33-C34	Reserved	Reserved	Reserved
C35-C36	Reserved	Reserved	Not Connected
C37	RF_GNSS_GND_1	Ground (RF_GNSS)	Ground (RF_GNSS)
C38	RF_GNSS	GNSS antenna input	GNSS antenna input ^a
C39	RF_GNSS_GND_2	Ground (RF_GNSS)	Ground (RF_GNSS)
C40	GPIO7	General purpose input/output	GPIO voltage output (reference voltage)
C41	VBAT_PA_EN/GPIO8	General purpose input/output	General purpose input/output
		Tx/Rx activity indicator/External RF voltage control	Tx/Rx activity indicator/External RF voltage control
C42	NC	Not Connected	Not Connected
C43	EXT_GPS_LNA_EN	Reserved	External GNSS LNA enable

Table 3-1: C Pins—HL78xx Series vs. Product Name (Continued)

C44	WAKEUP	Wake up signal	Wake up signal <i>Note: External pull down resistor 100K ohm is required</i>
C45	VGPI0	GPIO voltage output (reference voltage)	GPIO voltage output (reference voltage)
C46	GPIO6	General purpose input/output	General purpose input/output
C47	NC	Not Connected	Not Connected
C48	RF_MAIN_GND_1	Ground (RF_MAIN)	Ground (RF_MAIN)
C49	RF_MAIN	Main RF antenna input/output	Main RF antenna input/output
C50	RF_MAIN_GND_2	Ground (RF_MAIN)	Ground (RF_MAIN)
C51	GPIO14 /UART3_CTS	General purpose input/output	General purpose input/output, UART3_CTS, SPIM_CS
C52	GPIO10 /UART3_TX	General purpose input/output	General purpose input/output, UART3_CTS, SPIM_MOSI
C53	GPIO11 /UART3_RTS	General purpose input/output	General purpose input/output, UART3_CTS, SPIM_MISO
C54	GPIO15 /UART3_RX	General purpose input/output	General purpose input/output, UART3_CTS, SPIM_CLK
C55	UART0_RX	Debug Receive data	Debug Receive data
C56	UART0_TX	Debug Transmit data	Debug Transmit data
C57	UART0_CTS	Debug Clear To Send	Debug Clear To Send
C58	UART0_RTS	Debug Request To Send	Debug Request To Send
C59	PWR_ON_N	Active-low Power On control signal	Not Connected
C60	TX_ON	TX transmission indication	TX transmission indication
C61	VBAT_RF	Power supply	Power supply
C62	VBAT_RF	Power supply	Power supply
C63	VBAT_BB	Power supply	Power supply
C64	GPIO3 / UIM1_DET	UIM1 Detection	UIM1 Detection

Table 3-1: C Pins—HL78xx Series vs. Product Name (Continued)

C65	GPIO4	General purpose input/output	General purpose input/output
C66	GPIO5	General purpose input/output	General purpose input/output
CG1-CG4	GND	Ground	Ground
G1-G16	GND	Ground	Ground

a. For HL7900 only.

Table 3-2: B Pins—HL78xx Series vs. Product Name

Pad#	Signal Name	HL78xx Function	Product Name Function
B1	SF_SI/IO0	N/A	Serial Flash Input/Output (IO0) for Dual or Quad commands
B2	SF_SO/IO1	N/A	Serial Flash Input/Output (IO1) for Dual or Quad commands
B3	SF_nWP/IO2	N/A	Serial Flash Input/Output (IO2) for Dual or Quad commands
B4	SF_nHOLD/IO3	N/A	Serial Flash Input/Output (IO3) for Dual or Quad commands
B5	SF_CLK	N/A	Serial Flash Serial Clock
B6	NC	N/A	Not Connected
B7	EXT_ALARM	N/A	Alarm output
B8-B10	NC	N/A	Not Connected
B11	GPIO47	N/A	General purpose input/output
B12	NC	N/A	Not Connected
B13	WAKEUP_1_SHUB	N/A	Wake up signal
B14	VDD_PSRAM	N/A	Power source for external FLASH/PSRAM
B15-B23	NC	N/A	Not Connected

Table 3-2: B Pins—HL78xx Series vs. Product Name

B24	GPIO46	N/A	General purpose input/output
B25-B34	NC	N/A	Not Connected
B35, B37	GND	N/A	Ground
B38-B43	NC	N/A	Not Connected
B44	RFFE_SCLK	N/A	MIPI RFFE Clock signal
B45	RFFE_SDATA	N/A	MIPI RFFE directional/bi-directional data
B46-B50	GND	N/A	Ground
B51	PSRAM_CS _n	N/A	PSRAM _{chip} Select
B52	PSRAM_IO2	N/A	PSRAM_I/O 2
B53	PSRAM_IO0	N/A	PSRAM_I/O 0
B54	PSRAM_IO3	N/A	PSRAM_I/O 3
B55	PSRAM_IO1	N/A	PSRAM_I/O 1
B56	PSRAM_CLK	N/A	PSRAM_CLK
B57	SF_nCS1/PSRAM DQS	N/A	Serial Flash Chip Select 1 for SF_nCS1 / PSRAM DQS for PSRAM DQS
B58	EJ_TCK	N/A	JTAG ^a Test Clock
B59	EJ_TDO	N/A	JTAG ^a Test Data Output / Serial Wire
B60	EJ_TRST	N/A	JTAG ^a Test Reset
B61	EJ_TMS	N/A	JTAG ^a Test Mode Select / Serial Wire Debug
B62	EJ_TDI	N/A	JTAG ^a Test Data Input
B63	NC	N/A	Not Connected
B64	EJ_DEBUG_RST_N	N/A	Reset pin for the JTAG probe
B65	GND	N/A	Ground

- a. Support for JTAG is SKU dependent. Contact Semtech for more details.

3.1.2.1 Module Pin-outs

Note: Product Name does not support USB interface therefore Pin C 12, 13, and 16 USB interface are not supported.

The Ring C pin-outs of Product Name are pin-compatible with HL78xx modules. Product Name supports Ring B pin-outs. See the following table for the pin definitions.

Table 3-3: Product Name Module Pin Definitions

Function on Ring C (same with HL78)	Function on Ring B
UART1 (AT port)	JTAG
UART0 (debug port)	External Flash Memory
GPIOs	External RAM
Reset	MIPI Interface for Antenna Tuning
ADCs	External Alarm
External SIM	
Wake Up	
GNSS Pad (for HL7900 only)	
RF Pad	

It is recommended that a new PCB is designed and used for the Product Name module. If customer wants to use the Product Name with their current HL78xx design/PCB, refer to the following guidelines:

- Since Product Name does not support a USB interface, you may disable the USB function from the host side.
- Ring B should be NC if unused. Try to avoid any signal trace under the Product Name Ring B pads to avoid interference and shorting issues. It is recommended to have the copper ground plane covered by solder resist.
- A power supply designed for the HL78xx module is still valid for the Product Name due to the lower power requirements in all modes of operation.
- The pad size of Ring C on the Product Name matches that of the HL78XX Ring C pads.

3.1.3 Mounting Guidelines for the Product Name Modules

Avoid routing any high-speed noisy signals or sensitive traces under the module on the application PCB.

For additional information on mounting the module, refer to the Product Name Product Technical Specifications and other relevant documents as indicated in the [Reference Documents](#). You may also contact your Semtech representative for specific details and guidance.

3.1.4 Band Comparison

Table 3-4: HL7800, HL7802, HL7810, HL7812, and Product Name Supported Bands^a

Device	Cat-M1 and Cat-NB1 (or NB2)																							GSM				G N S S		
	B1	B2	B3	B4	B5	B8	B12	B13	B14	B17	B18	B19	B20	B23	B25	B26	B27	B28	B65	B66	B70	B85	B255	B256	GSM 850	E-GSM 900	DCS 1800		PCS 1900	
HL7800	M/N	M/N	M/N	M/N	M/N	M/N	M/N	M/N		N	M/N	M/N	M/N		M/N	M/N	M	M/N		M/N										Y
HL7802	M/N	M/N	M/N	M/N	M/N	M/N	M/N	M/N	M/N	N	M/N	M/N	M/N		M/N	M/N	M	M/N		M/N						Y	Y	Y	Y	Y
HL7810	M/N	M/N	M/N	M/N	M/N	M/N	M/N	M/N			M/N	M/N	M/N	NTN	M/N	M/N		M/N		M/N		M/N	NTN	NTN					Y	
HL7812	M/N	M/N	M/N	M/N	M/N	M/N	M/N	M/N			M/N	M/N	M/N	NTN	M/N	M/N		M/N		M/N		M/N	NTN	NTN	Y	Y	Y	Y	Y	
HL7900	M/N	M/N	M/N	M/N	M/N	M/N	M/N	M/N			M/N	M/N	M/N		M/N	M/N		M/N	N	M/N	N	N							Y	

a. M = Cat-M1 supported; N = Cat-NB1 (or NB2) supported; NTN=NB-NTN supported; Y = supported

Note: HL7900E did not support GNSS function.

3.1.5 Current Consumption

This section provides a comparison between the HL781x and Product Name module's current consumption in various power states or modes.

- Low Power Current Consumption Modes— [Table 3-5](#) to [Table 3-6](#)
- Connected Mode— [Table 3-7](#) to [Table 3-8](#)

The module's current consumption will depend on the actual operating/environmental conditions of the customer platform. The current consumption measurements presented in this section ([Table 3-5](#) to [Table 3-8](#)) are typical values obtained under the following test conditions:

- Nominal supply voltage-3.7V
- Nominal ambient temperature-25°C
- Conducted 50 load on RF port(s)
- External UICC/USIM that can be activated
- In addition, the following conditions apply to Hibernate
- VGPI0 is OFF
- Customer platform ensures module I/Os are not driven > 0.2V
- External UICC/USIM that is pre-configured to allow the module to automatically disable the USIM power
- WAKEUP signal Low

Table 3-5: HL781x, Product Name LPM Current Consumption - CAT-M

Modem Radio State	Lowest Power Mode	Details	HL7810 Current Value	HL7812 Current Value	HL7900 Current Value	HL7900E Current Value	Unit
PSM	Hibernate	Floor current during PSM dormant	2.8	1.8	1.1 - 1.5	1.1 - 1.7	µA
	Lite Hibernate		31	30	5 - 7	21 - 24	µA
	Hibernate Cycle ^a	<ul style="list-style-type: none"> ▪ T3412 = 24h ▪ T3324 = 20s 	10	8	1.8 - 2.3	2.6 - 2.8	µA
	Lite Hibernate Cycle ^a		36	33	5 - 7	22 - 25	µA
	Hibernate Cycle ^a		95	85	11 - 20	37 - 40	µA
	Lite Hibernate Cycle ^a		90	90	23 - 26	46 - 52	µA

Table 3-5: HL781x, Product Name LPM Current Consumption - CAT-M (Continued)

Modem Radio State	Lowest Power Mode	Details	HL7810 Current Value	HL7812 Current Value	HL7900 Current Value	HL7900E Current Value	Unit
eDRX	Hibernate	Floor current during eDRX	27	30	3 - 6	11 - 14	uA
	Lite Hibernate		29	32	8 - 11	21 - 24	uA
	Hibernate Cycle ^a	<ul style="list-style-type: none"> ▪ eDRX cycle (TI-eDRX) = 81.92s ▪ PTW and DRX = 1.28s 	41	50	5 - 8	20 - 22	uA
	Lite Hibernate Cycle ^a		42	52	10 - 13	29 - 33	uA
	Hibernate Cycle ^a	<ul style="list-style-type: none"> ▪ eDRX cycle (TI-eDRX) = 20.48s ▪ PTW and DRX = 1.28s 	90	100	15 - 20	45 - 49	uA
	Lite Hibernate Cycle ^a		93	110	20 - 25	54 - 59	uA
DRX	Running	DRX independent, +KSLEEP=2 or Wake active	40	40	9 - 13	11- 12	mA
	Sleep	1.28s	3	3	2.8 - 3.8	3.5 - 3.8	mA
	Hibernate		2	2	0.28 - 0.36	0.64 - 0.66	mA
	Sleep	2.56s	2.5	2.5	3 - 5	3.3 - 3.7	mA
	Hibernate		1.3	1.3	0.18 - 0.26	0.37 - 0.39	mA

a. This cycle (Lite Hibernate or Hibernate) includes boot, cell acquisition, network attachment, waiting for the timer's expiry, and going back to sleep.

Table 3-6: HL781x, Product Name LPM Current Consumption - CAT-NB

Modem Radio State	Lowest Power Mode	Details	HL7810 Current Value	HL7812 Current Value	HL7900 Current Value	HL7900E Current Value	Unit
PSM	Hibernate	Floor current during PSM dormant	2.8	1.8	1.2 - 1.5	1.1 - 1.4	µA
	Lite Hibernate		31	30	5 - 7	21 - 24	µA
	Hibernate Cycle ^a	<ul style="list-style-type: none"> ▪ T3412 = 24h ▪ T3324 = 20s 	12	8	2.2 - 2.5	2.6 - 2.8	µA
	Lite Hibernate Cycle ^a		33	33	6.4 - 7.8	22 - 25	µA
	Hibernate Cycle ^a	<ul style="list-style-type: none"> ▪ T3412 = 1h ▪ T3324 = 20s 	120	117	26 - 33	37 - 39	µA
	Lite Hibernate Cycle ^a		115	120	27 - 35	46 - 52	µA
eDRX	Hibernate	Floor current during eDRX	28	30	2.5 - 4	11 - 14	µA
	Lite Hibernate		32	33	8 - 11	21 - 24	µA
	Hibernate Cycle ^a	<ul style="list-style-type: none"> ▪ eDRX cycle (TI-eDRX) = 81.92s ▪ PTW and DRX = 1.28s 	70	75	9.5 - 13	24 - 27	µA
	Lite Hibernate Cycle ^a		72	80	10 - 16	33 - 37	µA
	Hibernate Cycle ^a	<ul style="list-style-type: none"> ▪ eDRX cycle (TI-eDRX) = 20.48s ▪ PTW and DRX = 1.28s 	210	220	30 - 38	63 - 67	µA
	Lite Hibernate Cycle ^a		212	227	36 - 40	71 - 77	µA
DRX	Running	DRX independent, +KSLEEP=2 or Wake active	45	45	11- 14	12 - 14	mA
	Sleep	1.28s	4.5	4.5	3 - 4.2	3.7 - 4	mA
	Hibernate		3.8	3.8	0.5 - 0.8	0.92 - 0.96	mA
	Sleep	2.56s	3.5	3.5	2.7 - 3.7	3.4 - 3.7	mA
	Hibernate		2.3	2	0.3 - 0.5	0.51 - 0.53	mA

a. This cycle (Lite Hibernate or Hibernate) includes boot, cell acquisition, network attachment, waiting for the timer's expiry, and going back to sleep.

Table 3-7: HL781x, Product Name Current Consumption - Connected Mode - Cat-M1

Parameter	Band	Output Power	HL7810 Avg. Current ^a	HL7812 Avg. Current ^a	Product Name Avg. Current ^a	Unit
<ul style="list-style-type: none"> ▪ Modem State: Connected ▪ 4RB DL at MCS 14 1RB_UL at MCS 15 ▪ Maximum 3 UL sub-frames and 3 DL sub-frames every 10 ms ▪ Transferring UDP payload data rates: concurrent 280 kbps DL + 45 kbps UL 	1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 85 ^b	23 dBm	200 - 240	170 - 230	110 - 170	mA
		0 dBm	120 - 190	120 - 140	30 - 70	mA

- a. Ranges reflect variations between band or channel combinations.
- b. HL781x band

Table 3-8: HL781x, Product Name Current Consumption - Connected Mode – CAT-NB2

Parameter	Band	Output Power	HL7810 Avg. Current ^a	HL7812 Avg. Current ^a	Product Name Avg. Current ^a	Unit
NB2 DL peak throughput (127 kbps) UL Subcarrier spacing: 15KHz Subcarriers downlink: 12 MCS.TBS:13	1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 65 ^b , 66, 70 ^b , 85	23 dBm	150 - 220,	160 - 190	70 - 120	mA
		0 dBm	100 - 170,	120 - 130	25 - 60	mA
NB2 UL peak throughput (158 kbps) UL Subcarrier spacing: 15KHz Subcarriers uplink:12 MCS.TBS:13		23 dBm	300 - 360,	220 - 285	180 - 260	mA
		0 dBm	150 - 310,	150 - 170	35 - 100	mA

- a. Ranges reflect variations between band or channel combinations.
- b. HL7900 band

Table 3-9: Power On Timing Table

Parameter	HL78			Product Name			Unit
	Min	Typ	Max	Min	Typ	Max	
T1: Delay between VBAT_BB and RESET_IN_N	-	-	200	-	-	30	ms
T2: Delay between RESET_IN_N and VGPIO	-	-	60	-	-	3	ms
T3: Delay between VGPIO and UART1_CTS	-	-	100	-	-	3.2	s
T4: Delay	-	-	10	-	-	5	s
T5: HW RESET_IN_N assertion time	100	-	-	10	-	-	ms
T6: Off delay between VGPIO and RESET_IN_N	-	-	30	-	-	63	μs

3.1.6 Wakeup Timing

Table 3-10: WAKEUP Timing (from OFF Mode)

Parameter	HL78			Product Name			Unit
	Min	Typ	Max	Min	Typ	Max	
T1: Delay between WAKEUP and VGPIO	-	-	1	-	-	420	μs
T2: Delay between VGPIO and UART1_CTS	-	-	20	-	-	3.2	s
T3: Delay	-	-	4	-	-	7	s

Table 3-11: WAKEUP Timing (from Lite Hibernate Mode)

Parameter	HL78			Product Name			Unit
	Min	Typ	Max	Min	Typ	Max	
T1: Delay between WAKEUP and AT-READY	-	-	80	-	-	20	ms

Table 3-12: WAKEUP Timing (from Hibernate Mode)

Parameter	HL78			Product Name			Unit
	Min	Typ	Max	Min	Typ	Max	
T1: Delay between WAKEUP and VGPIO	-	-	1	-	-	0.4	ms
T2: Delay between VGPIO and UART1_CTS high	-	-	20	-	-	60	μs
T3: UART1_CTS high to AT-READY	-	-	80	-	-	15	ms

3.1.7 Power On Sequence

On the Product Name, UART1 CTS is initially low for 2 seconds after power-up or reset. It then goes high and remains high until UART1 is ready to receive AT commands, at which point it goes low again. See [Figure 3-3](#) and the Product Name Product Technical Specification for details.

In HL78, the UART1 CTS stays high after boot up or reset until UART1 is ready. See [Figure 3-3](#) for a comparison.

For Product Name the host download tool (IBT) flow control is enabled for supporting faster download speeds (3 Mbits/s). Therefore, the UART1 CTS must be low during U-Boot so that IBT can recognize the module as ready for firmware updates. This low duration depends on the +KBOOTCFG bootdelay setting, which is 2 by default. For example, if bootdelay is 2, the CTS is low for 2 seconds. Meanwhile for HL78, since the download speed is just 921600bits/s, flow control is disabled and UART1 CTS stays high under u-boot.

The first CTS low transition is specifically the U-Boot window for potential firmware updates, not an indication that the module is ready for AT commands. When the module is fully booted, a second CTS low transition occurs, which is when the module is ready for AT commands.

On the host side, the following are recommended ways to confirm if the AT port is ready:

1. Monitor for "+KSUP" URC first, and only after receiving it, consider the module ready when CTS is low. This is the recommended approach for applications needing to know exactly when the module is ready.
2. For a simpler approach, ignore the first CTS low transition (which only lasts about 0.1s when bootdelay is set to 0, and 2 seconds in default).

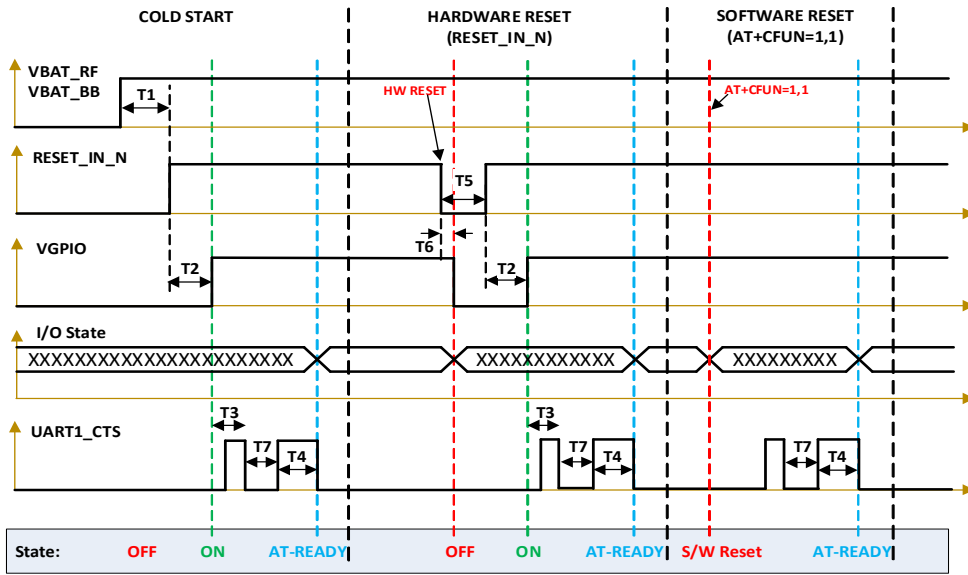


Figure 3-2: HL7900 Power On and Reset Sequence (unmanaged POWER_ON_N)

Table 3-13: Product Name POWER_ON_N Timing (unmanaged)^a

Parameter	Min	Typ	Max ^b	Unit
T1: Delay between VBAT_BB and RESET_IN_N	–	–	30	ms
T2: Delay between RESET_IN_N and VGPIO	–	–	3	ms
T3: Delay between VGPIO and UART1_CTS	–	–	3.2	s
T4: Delay	–	–	5 ^c	s
T5: HW RESET_IN_N assertion time	10	–	–	ms
T6: Off delay between VGPIO and RESET_IN_N	–	–	63	μs
T7: uboot delay	–	2	–	s

- a. Timing of first power cycle after FOTA/FW upgrade is not captured in this table.
- b. Measurements taken with HL78xx Development Kit
- c. Maximum time may extend to 40 seconds if there is an NV backup restore operation. Maximum time may extend to 20 seconds if the SIM card is unavailable.

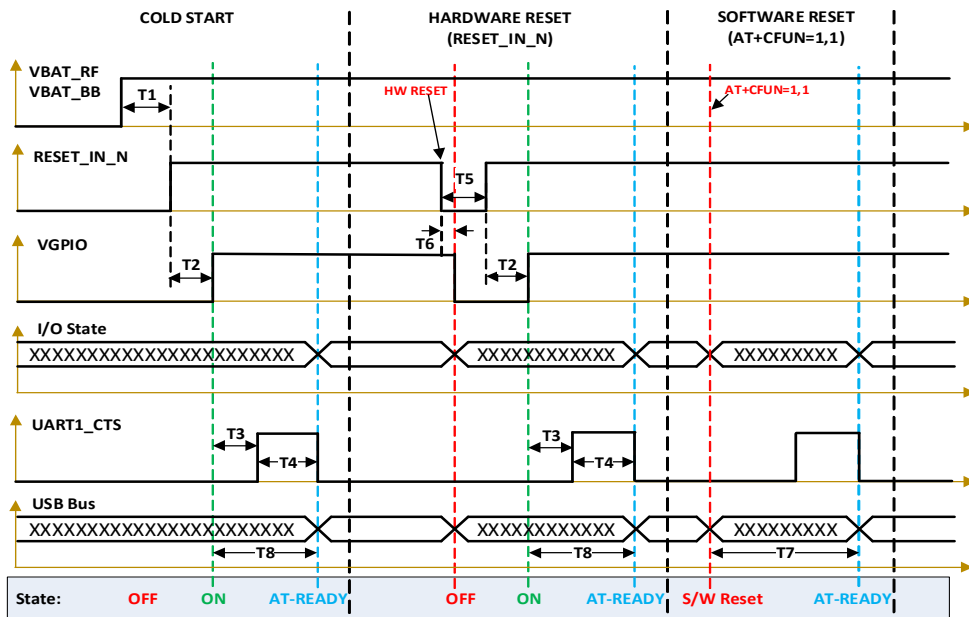


Figure 3-3: HL78 Power On and Reset Sequence (unmanaged POWER_ON_N)

Table 3-14: HL78 POWER_ON_N Timing (unmanaged)^a

Parameter	Min	Typ	Max ^b	Unit
T1: Delay between VBAT_BB and RESET_IN_N	–	–	200	ms
T2: Delay between RESET_IN_N and VGPIO	–	–	60	ms
T3: Delay between VGPIO and UART1_CTS	–	–	100	μs
T4: Delay	–	–	10 ^c	s
T5: HW RESET_IN_N assertion time	100	–	–	μs
T6: Off delay between VGPIO and RESET_IN_N	–	–	30	μs
T7: Delay between software reset and AT-READY (UART/USB)	–	–	10	s
T8: Delay between VGPIO and USB enumeration	–	–	T3 _{max} + T4 _{max}	s

- a. Timing of first power cycle after FOTA/FW upgrade is not captured in this table.
- b. Measurements taken with HL78xx Development Kit
- c. Maximum time may extend to 40 seconds if there is an NV backup restore operation. Maximum time may extend to 20 seconds if the SIM card is unavailable.

4: Software Information

This chapter shows an overview of the HL7900 module's software features.

4.1 Advanced Debugging

In the HL78xx modules, to allow Semtech to identify and resolve issues, run time debugging are relied upon since crash logs are not stored on the unit. This meant that field units had to be either monitored externally (impractical) or the issue had to be recreated in a controlled environment (sometimes not possible).

The Product Name logging mechanism is significantly improved as follows:

- History records are stored on the file system.
 - This eliminates the need to rely on runtime log debugging every time. Release 2 firmware supports logging crash events and will record additional events.
 - It provides indications as to the historic events of a given module.
- Remote debugging
 - This allows the ability to log a unit remotely when connected to the network. Whether this is appropriate depends on the scenario that it needs to be employed in.
 - This also provides real-time diagnostic mechanism.

This feature enables the end user to get historical logs from modules experiencing issues while using the local PC UART interface or by accessing it via the cloud (please discuss with a Semtech FAE how this can be achieved).

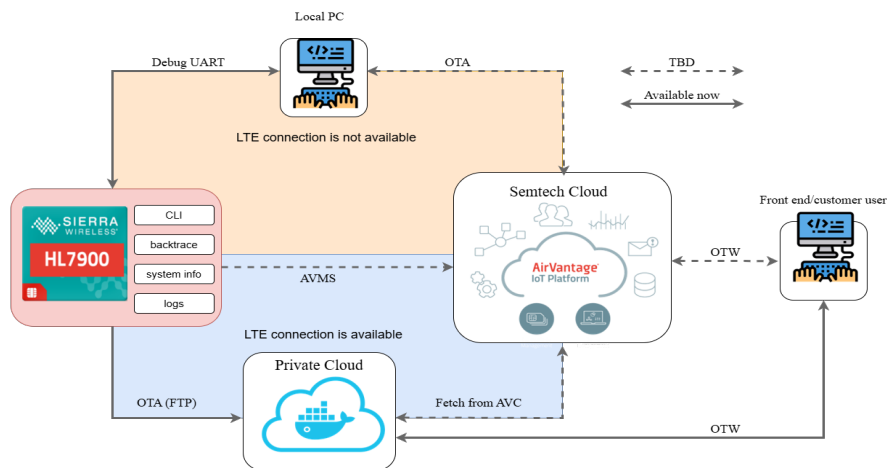


Figure 4-1: Remote Debugging feature in the Product Name

4.1.1 AT Commands

Some HL78xx AT commands are replaced on the Product Name based from the following list.

To see the details of these AT commands, download the latest Product Name AT Command Reference Guide and HL78xx AT Command Reference Guide from <http://source.sierrawireless.com> and refer to the Revision History of the document for the latest changes made.

Table 4-1: HL78xx to Product Name AT Command Change List

HL78xx		Product Name Alternative AT Commands
AT+KCELL	AT+KCELL=0	AT%SCAN="QUERY";1
		AT%MEAS="95"
		AT%MEAS="97"
	AT+KCELL=2,1	AT%SCANCFG=0
		AT%SCANCMD=0,1
		AT%SCANCMD=1
		AT%SCANCMD?
	AT+KCELL=2,1,1	AT%SCANCFG=1
		AT%SCANCMD=0,1
		AT%SCANCMD=1
		AT%SCANCMD?

Table 4-1: HL78xx to Product Name AT Command Change List (Continued)

HL78xx		Product Name Alternative AT Commands
AT+KCELLMEAS	AT+KCELLMEAS=0	AT%MEAS="0"
		AT%MEAS="6"
		AT%MEAS="4"
		AT%MEAS="2"
	AT+KCELLMEAS=1	AT%MEAS="0"
		AT%MEAS="6"
		AT%MEAS="4"
		AT%MEAS="2"
		AT+CRCES
		AT+CEINFO?

Table 4-1: HL78xx to Product Name AT Command Change List (Continued)

HL78xx		Product Name Alternative AT Commands
AT+KNWSCANCFG	AT+KNWSCANCFG?	AT%GETCFG="SC_POST_RLF"
		AT%GETCFG="SC_POST_NON_OPER"
		AT%GETCFG="SC_POST_RLF"
		AT%GETCFG="REPOSE_SCHEME1"
		AT%GETCFG="SC_POST_NON_OPER"
		AT%GETCFG="REPOSE_SCHEME2"
	AT+KNWSCANCFG=0,0,3,90,2	AT%SETCFG="REPOSE_SCHEME1";3;90;2;1"
		AT%SETCFG="SC_POST_RLF";1"
	AT+KNWSCANCFG=1,1,15,150	AT%SETCFG="REPOSE_SCHEME2";15;150;-1;1"
		AT%SETCFG="SC_POST_NON_OPER";2"
	AT+KNWSCANCFG=0	AT%SETCFG="SC_POST_RLF";0"
AT+KNWSCANCFG=1	AT%SETCFG="SC_POST_NON_OPER";0"	
AT+KSTATEV	AT+KSTATEV=1	AT%STATEV=1
AT+DMSUPPORT	AT+DMSUPPORT?	AT%GETACFG="modem_apps.LWM2M.AppEnable"
	AT+DMSUPPORT=1	AT%SETACFG="modem_apps.LWM2M.AppEnable";true"
	AT+DMSUPPORT=0	AT%SETACFG="modem_apps.LWM2M.AppEnable";false"
AT+DMSESSION	AT+DMSESSION=0	AT%LWM2MCMD="DEREGISTER"
	AT+DMSESSION=1	AT%LWM2MCMD="REGISTER"
	AT+DMSESSION=2	AT%LWM2MCMD="REGISTERUPD"
	AT+DMSESSION=3	AT%LWM2MCMD="BOOTSTRAP"

Table 4-1: HL78xx to Product Name AT Command Change List (Continued)

	HL78xx	Product Name Alternative AT Commands
AT+DMSETCFG	AT+DMSETCFG=0,X	AT%SETACFG="LWM2M.Config.ServiceCode";"X"
	AT+DMSETCFG=1,"XXXX"	AT%SETACFG="LWM2M.Config.NameMode";"XXXX"
	AT+DMSETCFG=2,"XXXXX"	AT%SETACFG="Identification.Model.Model";"XXXXX"
	AT+DMSETCFG=3,"YYYYYY"	AT%SETACFG="Identification.Device.DeviceSerialNumber";"YYYYYY"
AT+DMGETCFG	AT+DMGETCFG=0	AT%GETACFG="LWM2M.Config.ServiceCode"
	AT+DMGETCFG=1	AT%GETACFG="LWM2M.Config.NameMode"
	AT+DMGETCFG=2	AT%GETACFG="Identification.Model.Model"
	AT+DMGETCFG=3	AT%GETACFG="Identification.Device.DeviceSerialNumber"
AT+DMWRITE	AT+DMWRITE="3/0/17";"Test1"	AT%LWM2MCMD="SET_RESOURCE";3,0,17,,"Test1"
AT+DMREAD	AT+DMWRITE="3/0/17"	AT%LWM2MCMD="GET_RESOURCE";3,0,17
AT+DMCREDWRITE	AT!DMCREDWRITE=1,<BS_ADDR>	AT%LWM2MCMD="SET_RESOURCE";0,0,0,,"<BS_ADDR>"
	AT!DMCREDWRITE=2,<BS_PSK_ID>	AT%LWM2MCMD="SET_RESOURCE";0,0,3,,"<BS_PSK_ID>"
	AT!DMCREDWRITE=3,<BS_PSK>	AT%LWM2MCMD="SET_RESOURCE";0,0,5,,"<BS_PSK>"
AT+DMREAD	AT+DMREAD="3/0/17"	AT%LWM2MCMD="GET_RESOURCE";3,0,17
AT+DMEVENT	AT+DMEVENT=1,100	AT%LWM2MOPEV=1,100
AT+DMAPPDATA	AT+DMAPPDATA="123456",123,11542,0,"/19/0/0";"123"	AT%LWM2MOBJEV="123456",123,11542,0,"/19/0/0";"123"
AT+DMAPPRESP	AT+DMAPPRESP=3,"2.05"	AT%LWM2MOBJRSP=3,"2.05"
AT+DMAPPCMDIND	AT+DMAPPCMDIND=0	AT%LWM2MOBJCMD=0
	AT+DMAPPCMDIND=1	AT%LWM2MOBJCMD=1
AT+DMFOTAIND	AT+DMFOTAIND=0	AT%LWM2MEV=0
	AT+DMFOTAIND=1	AT%LWM2MEV=1

Table 4-1: HL78xx to Product Name AT Command Change List (Continued)

HL78xx		Product Name Alternative AT Commands
AT+DMFOTACFG	AT+DMFOTACFG?	AT%GETACFG="fotam_config.General.HostControl"
	AT+DMFOTACFG=0	AT%SETACFG="fotam_config.General.HostControl",0
	AT+DMFOTACFG=1	AT%GETACFG="fotam_config.General.HostControl",1
AT+DMFWUPGEV	AT+DMFWUPGEV=0	AT%FWUPGEV=0
	AT+DMFWUPGEV=1	AT%FWUPGEV=1
	AT+DMFWUPGEV=?	AT%FWUPGEV=?
URC		
+DMEVENT	+DMEVENT: xxxxx	%LWM2MOPEV: xxxxx
+DMAPPCMDIND	+DMAPPCMDIND: xxxxx	%LWM2MOBJCMDU: xxxxx
+DMFOTAIND	+DMFOTAIND: xxxxx	%LWM2MEV: xxxxx
+DMFWUPGEVU	+DMFWUPGEVU: xxxxx	%FWUPGEVU: xxxxx

The following AT commands have settings that are persistent over reboot with HL78 but not persistent with HL79. It is recommended to maintain the values from host side.

- AT+CMEE
- AT+CMGF
- AT+CSCA
- AT+CSCS
- AT+CGEREP
- AT+CEMODE

4.2 PSRAM

In HL7900, support for the PSRAM feature requires the use of the **APS1604M-SQR** PSRAM component. To enable:

1. Rebuild and download the new mcu.bin file.
2. Enable the configuration in the file located at projects/mcu_fw/GCC/defconfig:
CONFIG_EXTERNAL_PSRAM = y
CONFIG_DRIVER_DRV_PSRAM = y
CONFIG_CLI_PSRAM = y

Note:

- *The RTOS memory manager does not include this PSRAM component.*
 - *Customers need manage this additional memory region or utilize direct memory addressing.*
 - *This additional RAM is used as working memory without retention in hibernate mode.*
 - *You can directly access the memory buffer.*
 - *The PSRAM starts at address 0x03000000.*
 - *The valid memory range for the 2 MB PSRAM component spans from 0x03000000 to 0x031FFFFF.*
-

Sample demo command:

> psramTest all auto

For reference, see the sample code located at:

mcu\application\CLI\Source\cli_impl\psram_cli.c

4.3 HL7900E Feature Support Notice

HL7900 and HL7900E use the same modem software, but the HL7900E does not support the following features:

- Wi-Fi positioning
- iGNSS
- iSIM
- SRD

4.4 Manual Firmware Upgrade via LwM2M FOTA

Refer to the following information when doing a manual firmware upgrade via LwM2M FOTA:

```
/* Pre-Config, Set the FOTA download from Host */
```

```
AT%SETACFG="fotam_config.General.HostControl",1
```

```
AT+CFUN=1,1
```

```
/* Enable URCs for FOTA download */
```

```
AT%FWUPGEV=1
```

```
/* Waiting the URC <%FWUPGEVU: xxxxx> */
```

```
/* Check LwM2M REGISTRATION was completed */
```

```
/* Set FOTA Download operation From Server side */
```

```
/* Host side - Wait <%FWUPGEVU: "DLPENDING"> */
```

```
%FWUPGEVU: "DLPENDING"
```

```
/* Set accepts the FOTA download from Host side */
```

```
AT%FWUPGCMD="DLRSP",0
```

```
/* Waiting FOTA image Download via HTTP and Download Finish */
```

```
/* If the FOTA image download was completed */
```

```
%FWUPGEVU: "DLDONE"
```

```
/* Set FW Update operation from the Server side */
```

```
/* Host side waiting for the URC in the UPPENDING state */
```

```
%FWUPGEVU: "UPPENDING"
```

```
/* Host response for pending Update event */
```

```
AT%FWUPGCMD="UPRSP",0
```

```
/* Host side waiting for the URC in reboot state */
```

```
%FWUPGEVU: "REBOOTNEEDED"
```

```
/* Reboot the module let module do the FOTA upgrade */
```

```
AT+CFUN=1,1
```

```
/* Check the FW version after the Module was boot-up */
```

Server expect UE will send Notify for 5/0, then server recognize Finish correctly

5: References

For more details, several references can be consulted, as detailed below.

5.1 Website Support

Check <http://source.sierrawireless.com/> for the latest documentation available.

5.2 Reference Documents

- HL78xx Series Customer Process Guidelines
Reference: 4112095
- HL781x Product Technical Specification
Reference: 41114133
- HL78xx AT Command Reference Guide
Reference: 41111821
- HL7900 AT Command Reference Guide
Reference: 41114811
- HL7900/HL7900E Product Technical Specification
Reference: 41114801