1   Features

- The AWAC24U is a 2.4-GHz Direct Sequence Spread Spectrum (DSSS) transceiver USB Dongle that includes Cypress radio transceiver CyFi™ CYRF7936 and CY7C64215 enCoRe III Full Speed USB Controller Chips.
- Operates in the unlicensed worldwide Industrial, Scientific and Medical (ISM) band (2.400 GHz–2.483 GHz)
- Full speed USB (12Mbps)
- USB 2 compliant
- Dedicated 256 byte buffer
- Transmit power up to +21 dBm,
- Receive sensitivity up to –93 dBm
- Sleep Current less than 50 µA
- LOS Operating range of up to 1Km or more.
- DSSS data rates up to 250 kbps, GFSK data rate of 1 Mbps
- Auto Transaction Sequencer (ATS) - no micro controller intervention
- Framing, Length, CRC16, and Auto ACK
- Fast Startup and Fast Channel Changes
- Separate 16-byte Transmit and Receive FIFOs
- AutoRate™ - dynamic data rate reception
- Receive Signal Strength Indication (RSSI)
- No proprietary software required
- Operating voltage 5 volts
- Operating temperature from 0 to 70°C
- Size: 60mm x 20mm x 11mm including connector
- Weight: 5 gm
- FCC Part 15, ETSI EN 300 328-1, EN 301 489-1, EN 301 489-17 and Industry Canada RSS-210 Certified

2   Functional Description

The Artaflex AWAC24U Wireless USB dongle offers a complete radio module solution for integration into existing or new 2.4-GHz products.

AWAC24U is tested for functional operation and is FCC/ETSI (EU) certified. The module is supplied with an integrated chip antenna.

AWAC24U is available in a small PCB design and can be connected using the USB Type A / B connector. The pin-out of the USB connector is shown in the USB Connector Pin Information.

3   Applications

- **PC Human Interface Devices (HID)**
  - Wireless Keyboards and Mice
  - VoIP and Wireless Headsets
  - Wireless Gamepads
  - Remote Control
- **Consumer**
  - Sports and Leisure Equipment
  - Remote Controls
  - Audio Subwoofer
  - Presenter Tools
  - Locator Alarms
  - Toys
- **Building/Home Automation**
  - Automatic Meter Readers (AMR)
  - On-Site Paging Systems
  - Garage door opener
  - Alarm and Security
  - Lighting Control
  - Climate Control
  - Fan Control
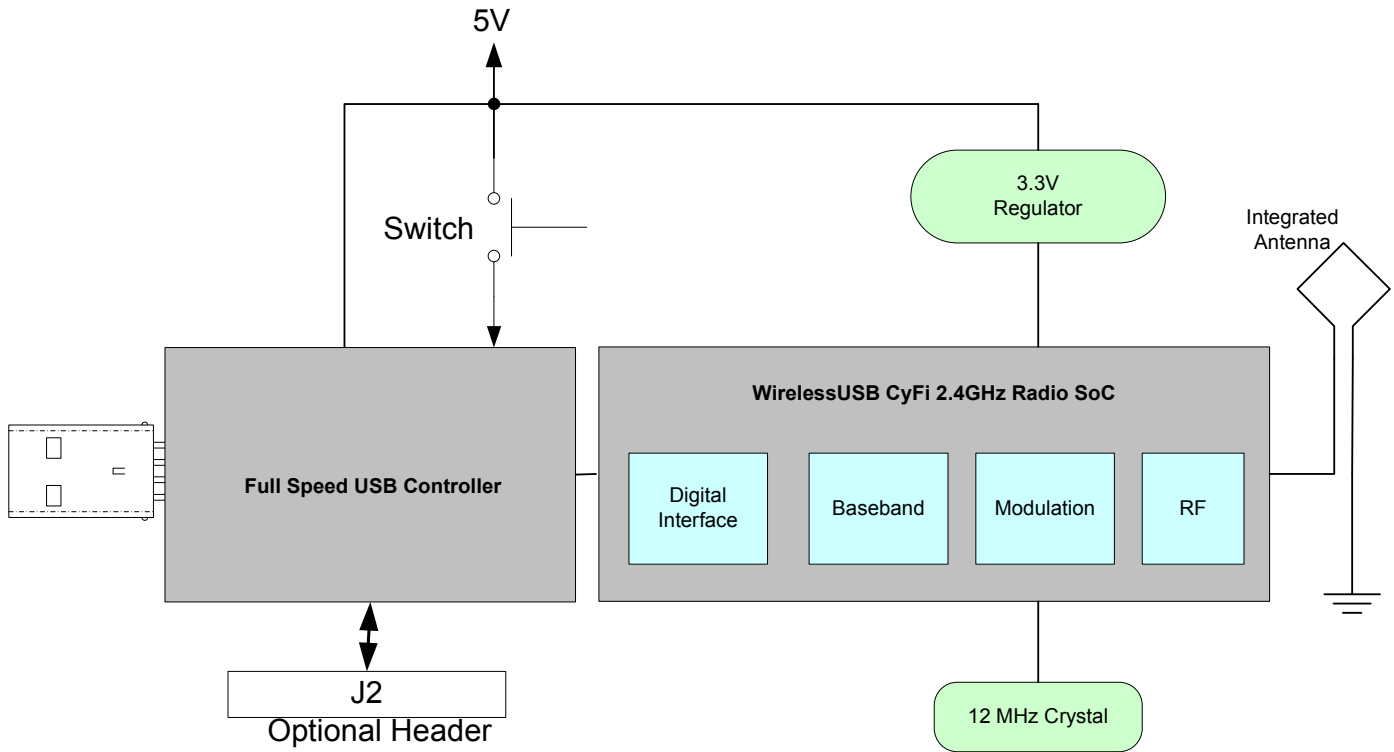- **Industrial Control**
  - Active RFID and asset tracking systems
  - Inventory Management
  - Point-of-sale systems
  - Factory Automation
  - Data Acquisition
  - USB to Serial
- **Transportation**
  - Remote Keyless Entry with acknowledgement (RKE)
  - Airline Baggage Tracking
  - Diagnostics

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Page 1 of 11

DSAWAC24U Rev 1v2
October 25, 2010

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Figure 1 - Module Block Diagram

3.1   Reference Documentation

Technical information such as register settings, timing, application interfaces, clocking, and power management for the Cypress Semiconductor CYRF7936 CyFi[TM] 2.4-GHz DSSS Radio System-on-Chip and the CY7C64215 enCoRe[TM] Full Speed USB Controller are available at www.cypress.com

The datasheet for CYRF7936 is available at:

http://download.cypress.com.edgesuite.net/design_resources/datasheets/contents/cyrf7936_8.pdf

The datasheet for CY7C64215 is available at:

http://download.cypress.com.edgesuite.net/design_resources/datasheets/contents/cy7c64215_8.pdf

For any firmware or technical details, please visit http://www.artaflexmodules.com/applications.html?cat_id=4
or post your queries at http://www.artaflexmodules.com/contact.html

4   Functional Overview

The AWAC24U Module provides a complete USB to RF antenna wireless MODEM. The module is designed to implement wireless device links operating in the worldwide 2.4-GHz ISM frequency band. It is intended for systems compliant with world-wide regulations covered by ETSI EN 301 489-1 V1.41, ETSI EN 300 328-1 V1.3.1 (Europe), FCC CFR 47 Part 15 (USA and Industry Canada) and TELEC ARIB(Japan).

The module contains a 2.4-GHz 1-Mbps GFSK radio transceiver, packet data buffering, packet framer, DSSS baseband controller, Received Signal Strength Indication (RSSI), and SPI interface for data transfer and device configuration.

The radio supports 98 discrete 1-MHz channels (regulations limit the use of some of these channels in certain jurisdictions, contact Artaflex for more details). In DSSS modes the baseband performs DSSS spreading/de-spreading, while in GFSK Mode (1 Mb/s - GFSK) the baseband performs Start of Frame (SOF), End of Frame (EOF) detection and CRC16 generation and checking. The baseband may also be configured to automatically transmit Acknowledge (ACK) handshake packets whenever a valid packet is received.

When in receive mode, with packet framing enabled, the device is always ready to receive data transmitted at any of the supported bit rates, except SDR, enabling the implementation of mixed-rate systems in which different devices use different data rates. This also enables the implementation of dynamic data rate systems, which use high data rates at shorter distances and/or in a low-moderate interference environment, and change to lower data rates at longer distances and/or in high interference environments.

4.1   Link Layer Modes

The AWAC24U module supports the following data packet framing features:

SOP – Packets begin with a 2-symbol Start of Packet (SOP) marker. This is required in GFSK and 8DR modes, but is optional in DDR mode and is not supported in SDR mode; if framing is disabled then an SOP event is inferred whenever two successive correlations are detected. The SOP_CODE_ADR code used for the SOP is different from that used for the "body" of the packet and if desired may be a different length. SOP must be configured to be the same length on both sides of the link.

EOP – There are two options for detecting the end of a packet. If SOP is enabled, then a packet length field may be enabled. GFSK and 8DR must enable the length field. This is the first 8-bits after the SOP symbol, and is transmitted at the payload data rate. If the length field is enabled, an End of Packet (EOP) condition is inferred after reception of the number of bytes defined in the length field, plus two bytes for the CRC16 (if enabled—see below). The alternative to using the length field is to infer an EOP condition from a configurable number of successive non-correlations; this option is not available in GFSK mode and is only recommended to enable when using SDR mode.

CRC16 – The device may be configured to append a 16-bit CRC16 to each packet. The CRC16 uses the USB CRC polynomial with the added programmability of the seed. If enabled, the receiver will verify the calculated CRC16 for the payload data against the received value in the CRC16 field. The starting value for the CRC16 calculation is configurable, and the CRC16 transmitted may be calculated using either the loaded seed value or a zero seed; the received data CRC16 will be checked against both the configured and zero CRC16 seeds.

CRC16 detects the following errors:

- Any one bit in error
- Any two bits in error (no matter how far apart, which column, and so on)
- Any odd number of bits in error (no matter where they are)
- An error burst as wide as the checksum itself

4.2   Packet Buffers

All data transmission and reception utilizes the 16-byte packet buffers—one for transmission and one for reception.

The transmit buffer allows a complete packet of up to 16-bytes of payload data to be loaded in one burst SPI transaction, and then transmitted with no further micro controller intervention. Similarly, the receive buffer allows an entire packet of payload data up to 16 bytes to be received with no firmware intervention required until packet reception is complete.

The AWAC24U module supports packet length of up to 40 bytes; interrupts are provided to allow a micro controller to use the transmit and receive buffers as FIFOs. When transmitting a packet longer than 16 bytes, the micro controller can load 16-bytes initially, and add further bytes to the transmit buffer as transmission of data creates space in the buffer. Similarly, when receiving packets longer than 16 bytes, the micro controller must fetch received data from the FIFO periodically during packet reception to prevent it from overflowing.

Artaflex Inc.
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L3R8T9   **Page 3 of 11**
(905) 479-0148

DSAWAC24U Rev 1v2
October 25, 2010

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4.3   Auto Transaction Sequencer (ATS)

The AWAC24U module provides automated support for transmission and reception of acknowledged data packets.

When transmitting a data packet, the device automatically starts the crystal and synthesizer, enters transmit mode, transmits the packet in the transmit buffer, and then automatically switches to receive mode and waits for a handshake packet and then automatically reverts to sleep mode or idle mode when either an ACK packet is received, or a timeout period expires.

Similarly, when receiving in transaction mode, the device waits in receive mode for a valid packet to be received, and then automatically transitions to transmit mode, transmits an ACK packet, and then switches back to receive mode to await the next packet. The contents of the packet buffers are not affected by the transmission or reception of ACK packets.

In each case, the entire packet transaction takes place without any need for micro controller firmware action; to transmit data the micro controller simply needs to load the data packet to be transmitted, set the length, and set the TX GO bit. Similarly, when receiving packets in transaction mode, firmware simply needs to retrieve the fully received packet in response to an interrupt request indicating reception of a packet.

4.4   Data Rates

By combining the DATA_CODE_ADR code lengths and data transmission modes described above, the AWAC24U supports the following modes and data rates.

Table 1 - Data Rates

RF Transmission Mode	Raw Data Rate kbps
GFSK	1,000.00
32-Chip 8DR	250.00
64-chip 8DR[1]	125.00
32-chip DDR[2]	62.50
64-chip DDR[2]	31.25
64-chip SDR[1,2]	15.63

5   Absolute Maximum Ratings

Storage Temperature .... –65°C to +150°C
Ambient Temperature with Power Applied............................. –55°C to +125°C
DC Voltage to Logic Inputs[3] .... –0.3V to V_{IO} +0.3V
DC Voltage applied to Outputs in High-Z State..................... –0.3V to V_{IO} +0.3V
Static Discharge Voltage (Digital)[4].. >2000V
Static Discharge Voltage (RF)[4].. 1100V
Latch-up Current .... +200 mA, –200 mA

6   Operating Conditions

V_{CC} (J2)... 5.00V
V_{CC} (USB)... 5.00V
T_A (Ambient Temperature under Bias)............0°C to +70°C
Ground Voltage...0V

Notes

[1].   Typically data modes with high chip encoding which provides a higher process gain and lower data rates provide longer range and / or a more robust wireless link.
[2].   This mode is compatible with Cypress Generation 1 RF WirelessUSB transceiver devices, CYWUSB6934 and CYWUSB6935.
[3].   It is permissible to connect voltages above V_{IO} to inputs through a series resistor limiting input current to 1 mA. AC timing not guaranteed.
[4].   Human Body Model (HBM).

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L3R8T9
(905) 479-0148

DSAWAC24U Rev 1v2
October 25, 2010

Page 4 of 11

http://www.artaflexmodules.com

7 DC Characteristics (T = 25°C, V_{cc} = 2.4V, f_{OSC} = 12.000 MHz)

Table 2 - DC Characteristics

Parameter	Description	Conditions	Typ.	Max.	Unit
V_{CC}	Power Supply Voltage	0 to 70ºC	5.00	5.5	V
TX I_{CC}	I_{CC} during Transmit	PA = 7 (+20dBm)	200	240	mA
RX I_{CCoff}	I_{CC} during Receive	LNA off, ATT on	33	45	mA
RX I_{CCon}	I_{CC} during Receive	LNA on, ATT off	35	48	mA
I_{SB}	Sleep Mode Current I_{cc}		10	40.0	µA

Artaflex Inc.
215 Konrad Crescent
Markham, Ontario, Canada
L3R8T9   **Page 5 of 11**
(905) 479-0148

DSAWAC24U Rev 1v2
October 25, 2010

http://www.artaflexmodules.com

8 RF Characteristics

Table 3 – Radio Parameters

Parameter Description	Conditions	Min.	Typ.	Max.	Unit
RF Frequency Range		2.400		2.483	GHz
Receiver (T=25°C, VCC = 3.0V, f_{OSC} = 12.000000MHz, BER < 1E-3)					
Sensitivity 125kbps 64-8DR	BER 1E-3		–93		dBm
Sensitivity 250-kbps 32-8DR	BER 1E-3		–89		dBm
Sensitivity	CER 1E-3	–80	–83		dBm
Sensitivity GFSK	BER 1E-3, ALL SLOW = 1		–80		dBm
LNA gain			22.8		dB
ATT gain			–31.7		dB
Maximum Received Signal	LNA On	–15	–6		dBm
RSSI value for PWR_{in} –60 dBm	LNA On		21		Count
RSSI slope			1.9		dB/Count
Interference Performance (CER 1E-3)					
Co-channel Interference rejection Carrier-to-Interference (C/I)	C = –60dBm		9		dB
Adjacent (±1 MHz) channel selectivity C/I 1 MHz	C = –60dBm		3		dB
Adjacent (±2 MHz) channel selectivity C/I 2 MHz	C = –60dBm		–30		dB
Adjacent (> 3 MHz) channel selectivity C/I > 3 MHz	C = –67dBm		–38		dB
Out-of-Band Blocking 30 MHz–12.75 MHz[	C = –67dBm		–30		dBm
Intermodulation	C = –64dBm, Δf = 5, 10 MHz		–36		dBm
Receive Spurious Emission					
800 MHz	100-kHz ResBW		–79		dBm
1.6GHz	100-kHz ResBW		–71		dBm
3.2 GHz	100-kHz ResBW		–65		dBm
*Transmitter (T = 25°C, VCC = 3.0V)					
*Maximum RF Transmit Power	PA = 7	18	20	21	dBm
Maximum RF Transmit Power	PA = 6	16	17	18	dBm
Maximum RF Transmit Power	PA = 5	13	14	15	dBm
Maximum RF Transmit Power	PA = 4	9	11	12	dBm
*Maximum RF Transmit Power	PA = 3	7	8	10	dBm
Maximum RF Transmit Power	PA = 2	4	5	7	dBm
Maximum RF Transmit Power	PA = 1	-2	-1	0	dBm
Maximum RF Transmit Power	PA = 0	-7	-5	-2	dBm
RF Power Control Range			*39		dB
RF Power Control Range Step Size	seven steps, monotonic		3-5		dB
Frequency Deviation Min	PN Code Pattern 10101010		270		kHz
Frequency Deviation Max	PN Code Pattern 11110000		323		kHz
Error Vector Magnitude (FSK error)	>0 dBm		10		%rms
Occupied Bandwidth	–6 dBc, 100-kHz ResBW	500	876		kHz

Table 3 – Radio Parameters (continued)

Parameter Description	Conditions	Min.	Typ.	Max.	Unit
Transmit Spurious Emission (PA = 7)					
In-band Spurious Second Channel Power (±2 MHz)			–38		dBm
In-band Spurious Third Channel Power (>3 MHz)			–44		dBm
Non-Harmonically Related Spurs (800MHz)			–38		dBm
Non-Harmonically Related Spurs (1.6GHz)			–34		dBm
Non-Harmonically Related Spurs (3.2GHz)			–47		dBm
Harmonic Spurs (Second Harmonic)			–43		dBm
Harmonic Spurs (Third Harmonic)			–48		dBm
Fourth and Greater Harmonics			–59		dBm
Power Management (with 30ppm crystal)					
Crystal start to 10ppm			0.7	1.3	ms
Crystal start to IRQ	XSIRQ EN = 1		0.6		ms
Synth Settle	Slow channels			270	µs
Synth Settle	Medium channels			180	µs
Synth Settle	Fast channels			100	µs
Link turn-around time	GFSK			30	µs
Link turn-around time	250 kbps			62	µs
Link turn-around time	125 kbps			94	µs
Link turn-around time	<125 kbps			31	µs
Max. packet length	<60ppm crystal-to-crystal all modes except 64-DDR			40	bytes
Max. packet length	<60ppm crystal-to-crystal 64-DDR			16	bytes

8.1   FCC Operating Requirements in North America

Customer should make sure that maximum power setting i.e PA7 is only used between CH06-65. For Channels outside CH No. 06-65 i.e CH No. 01-04 and 66-79 the maximum power level allowed is PA3. Any configuration other than what's mentioned above will violate the FCC grant issued for this hardware.

8.2   ETSI Operating Requirements for EU

Device can operate between CH No. 01-79 only with Power setting equal or below PA3. Using any setting above PA3 will violate the ETSI regulations for max output power.

9   RF Exposure Requirements

To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.

The antenna is integrated in the module and has been qualified and approved for use under the Approval certification. This antenna may not be modified or altered in any way from the original design as represented by Artaflex Inc.

The integrated antenna has been specifically tested with the AWAC24U, and certified through the regulatory agencies in the US, Canada, and European Union for authorized use. Use of an altered antenna in the AWAC24U will void certification. Changes or

Artaflex Inc.
215 Konrad Crescent
Markham, Ontario, Canada
L3R8T9   **Page 7 of 11**
(905) 479-0148

DSAWAC24U Rev 1v2
October 25, 2010
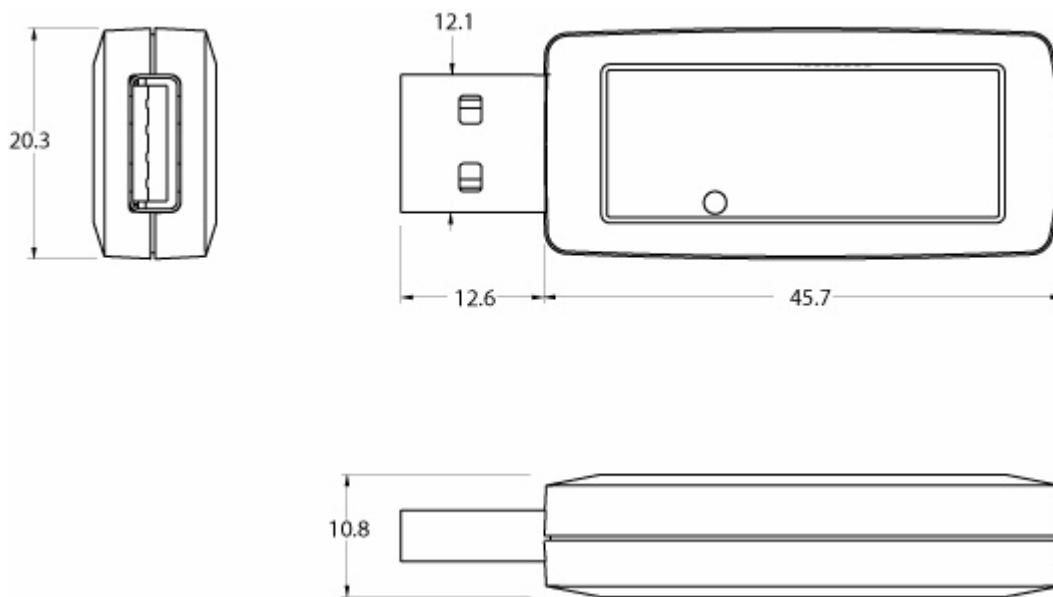
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modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

For more details on the proper installation requirements please review Artaflex USB Dongle Application Notes.

10   Mechanical Package Description

Dimensions are in mm

Figure 2 - Mechanical Diagram

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L3R8T9
(905) 479-0148

DSAWAC24U Rev 1v2
October 25, 2010

Page 8 of 11

http://www.artaflexmodules.com

11 Connector

Table 4 – USB Connector Pin Information

Pin	Name	Type	Default	Description
1	VCC	Power	VCC	Main Supply 5V
2	DN	I/O	-	Data -
3	DP	I/O	-	Data +
4	GND	Power	GND	Ground
5	S1	I/O	Pull Down	Not used
6	S2	I/O	Pull Down	Not Used

Table 5 – Optional Header J2

Pin	Name	Type	Default	I^2C Configuration	SPI Configuration
1	VCC	Power	VCC	Main Supply 5V	Main Supply 5V
2	P1	I/O	-	No Connect	MISO
3	P2	I/O	-	Data	MOSI
4	P3	I/O	-	Clock	Clock
5	P4	I/O	-	No Connect	$\overline{SS}$
6	GND	I/O	GND	Ground	Ground

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Markham, Ontario, Canada
L3R8T9
(905) 479-0148

DSAWAC24U Rev 1v2
October 25, 2010

Page 10 of 11

http://www.artaflexmodules.com

12 Ordering Information

12.1 Standard Part Numbers

Part Number	Description	Temperature
AWA24U-FSAP-C-UC	Wireless USB Dongle with Type A Plug in Commercial Temperature	0 to 70ºC

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215 Konrad Crescent
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L3R8T9   **Page 11 of 11**
(905) 479-0148

DSAWAC24U Rev 1v2
October 25, 2010

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