**A citrus fruit on a table

Description automatically generated**

**TangerineSDR**

*TangerineSDR*

*Clock Module (CKM)*

Interface Control Document

Version Number: 0.1

Version Date: July 10, 2019

Document Number: TSDR\_CKM\_ICD

VERSION HISTORY

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Version Number** | **Implemented**  **By** | **Revision**  **Date** | **Approved**  **By** | **Approval**  **Date** | **Description of Change** |
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# Introduction

The Personal Space Weather Station (PSWS) Clock Module provides GPS derived time and frequency for input to the PSWS TangerineSDR receiver Data Engine (DE). It is a low cost module that provides a high accuracy pulse-per-second (PPS) timing strobe, high-accuracy UTC time, and programmable frequency synthesizer outputs derived from a GPS disciplined oscillator. The four synthesizer outputs have phase noise performance that meets the needs of the PSWS receiver. The module is intended to be programmed from the DE, and to provide timing and frequency signals to the DE. Figure 1 is a block diagram of the Clock Module.

**Figure 1. Block Diagram of Clock Module**

GNSS / GPS

Receiver +

Holdover

SPI Interface

Antenna Power & Protection

Frequency Synthesizer

I2C Interface

GPS

Antenna

Freq ref

PPS Output

Optional External 10 MHz Freq ref

The clock module contains a holdover oscillator which continues the phase and frequency outputs when GPS receiver signal is lost. It uses a low-phase-noise oscillator with frequency stability correction. The holdover oscillator may be integrated within the GPS receiver, or it may be outside the receiver but contained on the module.

## References

The PSWS Clock Module Specification describes the purpose, use cases, functionality and performance requirements for the clock module.

## GPS Receiver

The GPS receiver registers, block diagrams, and control / status maps are available from the manufacturer programming document. While the exact GPS module choice is still TBD, a representative module would be the U-blox LEA-M8F.

* All Documentation located at:

[https://www.u-blox.com/en/product/lea-m8f-module#tab-documentation-resources](https://www.u-blox.com/en/product/lea-m8f-module%23tab-documentation-resources)

* Datasheet: UBX-14001772
* Hardware Integration Manual: UBX-14000034
* System Integration Guide: UBX-14001603
* Receiver Description + Protocol Specification: UBX-13003221

## Synthesizer

The Synthesizer registers, block diagrams, and control / status maps are available from the manufacturer programming document. While the exact Synthesizer choice is still TBD, a representative choice would be the Silicon Labs SI-5344 D.

* The documentation is not centrally collected, individual links are needed.
* Evaluation Board User’s Guide: <https://www.silabs.com/documents/public/user-guides/Si5344-D-EVB.pdf>
* Datasheet: <https://www.silabs.com/documents/public/data-sheets/Si5345-44-42-D-DataSheet.pdf>
* Reference Manual: <https://www.silabs.com/documents/public/reference-manuals/Si5345-44-42-D-RM.pdf>

# Electrical Interfaces

This section defines the electrical interfaces of the Clock Module, including the connectors, connector pin outs, signals, and signal formats. All signals are contained on a single M.2 connector. The module has two intended uses:

1. Plug onto a TangerineSDR Data Engine board using the M.2 connector.
2. Independent use by plugging onto a breakout board which routes the M.2 connector to various SMA, SPI, and I2C connectors.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **J1 – GPS and Synthesizer Control and Status, PPS and Synthesizer Outputs**  **Connector type: M.2 – xx-Keyed (B key ? or M key ?)** | | | | |
| **Note the Pins numbers are WRONG and arbitrary at this time.**  **The Exact pin layout will need to await the ICD for the Data Engine and analysis to prevent module interchangeability and potential power mis-supply problems.** | | | | |
| **Connector Pin #** | **Signal Name** | **Signal Electrical Format** | **Input / Output / Bidirectional** | **Description** |
| 1 | PPS+ | LVDS | O | GPS Pulse Per Second differential positive |
| 2 | PPS- | LVDS | O | GPS Pulse Per Second differential negative |
| 3 | GND |  |  |  |
|  |  |  |  | GPS Receiver Control and Status (SPI) |
| 4 | SPI | 3V CMOS | I | SCLK |
| 5 | SPI | 3V CMOS | I | MOSI |
| 6 | SPI | 3V CMOS | O | MISO |
| 7 | SPI | 3V CMOS | I | SS |
| 8 | GND |  |  |  |
|  |  |  |  | Synthesizer Control and Status (I2C) |
| 9 | I2C | 3V CMOS | B | SDA |
| 10 | I2C | 3V CMOS | I | SCL |
| 11 | GND |  |  |  |
|  |  |  |  | Synthesizer Outputs |
| 12 | Syn1+ | LVDS | O | Synthesizer 1 Positive |
| 13 | Syn1- | LVDS | O | Synthesizer 1 Negative |
| 14 | GND |  |  |  |
| 15 | Syn2+ | LVDS | O | Synthesizer 2 Positive |
| 16 | Syn2- | LVDS | O | Synthesizer 2 Negative |
| 17 | GND |  |  |  |
| 18 | Syn3+ | LVDS | O | Synthesizer 3 Positive |
| 19 | Syn3- | LVDS | O | Synthesizer 3 Negative |
| 20 | GND |  |  |  |
| 21 | Syn4+ | LVDS | O | Synthesizer 4 Positive |
| 22 | Syn4- | LVDS | O | Synthesizer 4 Negative |
| 23 | GND |  |  |  |
|  |  |  |  | Status Outputs ( RESERVED if necessary to clock some time critical function in the FPGA ) |
| 24 | Status 1+ | LVDS | O | Output – Status 1 Positive (function TBD) |
| 25 | Status 1- | LVDS | O | Output – Status 1 Negative |
| 26 | GND |  |  |  |
| 27 | Status 2+ | LVDS | O | Output – Status 2 Positive (Function TBD) |
| 28 | Status 2- | LVDS | O | Output – Status 2 Negative |
| 29 | GND |  |  |  |
|  |  |  |  | DC Power |
| 30, 31 | +3.3 | Power | I | +3.3 VDC Power. Current TBD |
| 32, 33 | +5 | Power | I | + 5 VDC Power. Current TBD. |
| 34 | GND |  |  |  |
|  |  |  |  |  |
| TBD | M.2 CONNECTOR KEY | | |  |
|  |  |  |  |  |
|  |  |  |  | GPS Antenna |
| 39 | GND |  |  |  |
| 40 | GND |  |  |  |
| 41 | GPS Antenna | 50 ohm RF Coaxial also supplying power | B | Output - Provides current-limited DC power (+3.3VDC or +5VDC TBD) to the GPS antenna.  Input – receives the 1.5 GHz GPS signal from the antenna. |
| 42 | GND |  |  |  |
| 43 | GND |  |  |  |
|  |  |  |  | External Reference Clock |
| 44 | GND |  |  |  |
| 45 | GND |  |  |  |
| 46 | External 10 MHz Reference | 50 ohm RF Coaxial | I | Input – Receives Optional External 10 MHz reference inputs. Terminated 50 ohms. |
| 47 | GND |  |  |  |
| 48 | GND |  |  |  |
|  |  |  |  |  |

# Mechanical Interfaces

This section describes the mechanical packaging of the clock module, including board profile, mounting and screw holes, and connector placement.

The module profile is shown in Figure 3.1. TBD. The module dimensions are TBD.

The Main electrical connector type is TBD (might be M.2?). The module mounts to the PSWS Data Engine as shown in figure 3.2 using a TBD screw at the locations shown in the profile drawing.