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MEPT - a WSPR beacon

Versionsgeschichte interaktiv durchsuchen  
VisuellWikitext

Version vom 1. Juli 2009, 09:21 Uhr (Quelltext anzeigen)  
Oe1mcu (Diskussion | Beiträge)  
← Zum vorherigen Versionsunterschied

Aktuelle Version vom 1. Juli 2009, 15:48 Uhr (Quelltext anzeigen)  
Oe1mcu (Diskussion | Beiträge)  
(→MEPT SWITCH Module)

(25 dazwischenliegende Versionen desselben Benutzers werden nicht angezeigt)

Zeile 1:

[[Kategorie:Selbstbau]]

[[Kategorie:digitale\_Betriebsarten]]

== VERSATILE WSPR BEACON for MOBILE and FIXED applications ==

Zeile 1:

[[Kategorie:Selbstbau]]

[[Kategorie:digitale\_Betriebsarten]]

== Vielseitige WSPR Bake für mobile und stationäre Anwendungen ==

MEPT = Manned Experimental Propagation Transmitter

Die MEPT [[WSPR]] Bake sendet für 2 Minuten die [[WSPR]] Bake und wechselt dann automatisch auf ein anderes Band. Die Zeit und den Locator holt sich die Bake vom angeschlossenen GPS Empfänger. Damit können alle Kurzwellen Amateurfunkbänder und 6m abgedeckt werden. Das Gerät ist kompakt aufgebaut und benötigt für den Betrieb keinen Computer was den Stromverbrauch signifikant senkt.

[[Bild:MEPT 1.jpg]]

Es dauerte einige Monate - aber jetzt ist es (fast) fertig.

- + **Das Baken Konzept beruht auf getrennten Modulen die nach den speziellen Anforderungen kombiniert werden können.**
- +
- + **== Anschlüsse: ==**
- +
- + **\* "'USB interface'" für die Windows Konfigurations Software**
- + **\* "'serial interface'" zum Anschluss der GPS Maus**
- + **\* "'SPI bus'" für die Datenübermittlung zwischen den Modulen**
- + **\* "'ICSP'" zum programmieren des PIC Prozessors**
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- + **== Ausstattung: ==**
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- + **\* Windows Konfigurationssoftware**
- + **\* Die Bake läuft unabhängig vom PC**
- + **\* Zeit und geographische Position werden hochgenau aus dem GPS Signal gewonnen**
- + **\* Unabhängige Generierung des WSPR Datensatz im Mikrocontroller der Bake**
- + **\* Bis zu 8 verschiedene Filter über eine Filterschaltbox anwählbar**
- + **\* Bis zu 4 Dämpfungsglieder Netzwerke durch die Abschwächer Box steuerbar**
- + **\* Mehrere DDS & PA Module an einem Controller anschließbar**
- + **\* DDS & PA Modul für 1.8-50MHz mit bis zu 15W**

|                                                      |  |                                                                                                                                                                                                                                             |
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|                                                      |  | + * Bänder (160m / 80m / 40m / 30m / 20m/ 17m / 15m / 12m / 10m / 6m)                                                                                                                                                                       |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  |                                                                                                                                                                                                                                             |
| - MEPT = Manned Experimental Propagation Transmitter |  | +                                                                                                                                                                                                                                           |
|                                                      |  | + At the moment there are two modules. The CPU box with a DDS/PA module and a switch box that can hold up to 8 filter and one attenuator modules                                                                                            |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | + [[Bild:MEPT_2.jpg]]                                                                                                                                                                                                                       |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | + == MEPT SWITCH Modul ==                                                                                                                                                                                                                   |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | + [[Bild:MEPT DDS Filter Controller v2.0.jpg thumb Controller board circuit]]                                                                                                                                                               |
|                                                      |  | + [[Bild:MEPT DDS Filter Switch v2.0.jpg thumb Switch board circuit]]                                                                                                                                                                       |
|                                                      |  |                                                                                                                                                                                                                                             |
|                                                      |  |                                                                                                                                                                                                                                             |
| - [[Bild:MEPT 1.jpg]] [[Bild:LCD position.jpg]]      |  | + The switch module can hold up to 8 filter or attenuator boards. For bands from 160m to 6m elliptical low pass filters are ready. I am planning a band pass filter for 6m as the local oscillator signals are below the working frequency. |
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|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
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|   |                                                                                                                 |  |  |  | There will be another switch board with 4 instead of 8 positions that will be able to hold attenuator boards of the same size.                                                                                                                                                                                                                                         |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  | [[Bild:MEPT 8.jpg]]                                                                                                                                                                                                                                                                                                                                                    |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  | == MEPT CONFIGURATIONS ==                                                                                                                                                                                                                                                                                                                                              |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | It took me a couple of month - but now it's (almost) ready.                                                     |  |  |  | ""BASIC Configuration""                                                                                                                                                                                                                                                                                                                                                |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | A versatile beacon concept that consists of a number modules that can be combined according to the application. |  |  |  | The beacon system can be configured in various scenarios. The most simple one is the CPU unit with the integrated PA used stand alone. In this setup a LPF filter module is installed within the CPU box. So beaconing is only possible on one band. Either fixed - with pre programmed Locator - or mobile where location information is derived from the GPS signal. |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | == Connectors: ==                                                                                               |  |  |  | [[Bild:config1.jpg 400px]]                                                                                                                                                                                                                                                                                                                                             |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""USB interface"" to connect to a Windows application for configuration                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""serial interface"" to attach a GPS mouse                                                                    |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""SPI bus"" to interconnect the modules                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""ICSP"" for in circuit serial programming of the PIC processor                                               |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  | ""Multiband Configuration""                                                                                                                                                                                                                                                                                                                                            |

## == Features: ==

In this setup the filter module in the CPU/PA module is removed and a Filter Switch Module is installed in the signal path. Through the SPI bus the CPU controls the Filter Switch Module. The module can hold up to 8 filter boards, hence enabling the system to transmit on up to eight different bands. Additionally an attenuator module can be installed in the Filter Switch Module allow driving of a non resonant antenna. Again fixed and mobile operation is possible. In mobile applications usually a smaller number of bands will be choosen, optimizing probability to be heard at all.

\* Configuration software for Windows

[[Bild:MEPT Config2.jpg|400px]]

\* Beacon runs independent from PC

\* Time and Location can be derived from GPS signal

\* Autonomous generation of WSPR data string in local microcontroller

\* Up to 8 different filters selectable through filter switch box

\* Up to 4 Attenuator networks selectable through attenuator switch box

\* Multiple DDS & PA modules attachable to one controller

\* DDS & PA module for 1.8-50MHz with up to 15W

'''Multiband Confiquration with Attenuator Switch'''

|   |                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| - | <div>[[Bild:MEPT_2.jpg]]</div>                                                                                                                            | + | <div>[[Bild:config3.jpg 400px]]</div>                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   |                                                                                                                                                           | + | <div>'''Multiband Configuration with Multiple DDS/PA Modules</div>                                                                                                                                                                                                                                                                                                                                                                                         |
|   |                                                                                                                                                           | + | <div>When running the beacon in Multiband config with a filter box with 8 boards installed, one will only reach a TX time of 12,5%. To increase the TX time to 25% (or higher) with still covering 8 bands (or more) additional DDS/PA modules with individual Filter Switch Modules can be driven from a single CPU. These signal sources can be attached to diffent antennas as shown, or through a LPF/HPF signal combiner into a single antenna.</div> |
| - | <div>Here you can find an overview of the possible configurations</div>                                                                                   | + | <div>[[Bild:MEPT Config4.jpg 400px]]</div>                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   |                                                                                                                                                           | + | <div>&lt;br&gt;&lt;br&gt;</div>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| - | <div>[[MEPT CONFIGURATIONS]]</div>                                                                                                                        | + | <div>== MEPT CPU Modul ==</div>                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   |                                                                                                                                                           | + | <div>[[Bild:MEPT DDS CPU v6.0.jpg thumb MEPT CPU board circuit]]</div>                                                                                                                                                                                                                                                                                                                                                                                     |

|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|---|--|--|--------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |  |  |                                                                    |  | <div>[[Bild:MEPT DDS Displav Unit v1.0.jpg thumb MEPT Display board circuit]]</div>                                                                                                                               |
|   |  |  |                                                                    |  | <div>[[Bild:MEPT_DDS RF unit v2.1.jpg thumb MEPT DDS &amp; PA board circuit]]</div>                                                                                                                               |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  | <div>The main module holds the CPU with USB and GPS serial interface, the master oscillator and one DDS with a 15W PA module. It can be run stand alone and accepts one filter module on the RF unit board.</div> |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
| - |  |  | A detailed description of the individual modules can be found here |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  | <div>&lt;gallery&gt;</div>                                                                                                                                                                                        |
|   |  |  |                                                                    |  | <div>Bild:MEPT 4.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |  |  |                                                                    |  | <div>Bild:MEPT 5.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |  |  |                                                                    |  | <div>Bild:MEPT 6.jpg GPS Satelliten Suche</div>                                                                                                                                                                   |
|   |  |  |                                                                    |  | <div>Bild:MEPT 7.jpg Warten auf Sendeslot</div>                                                                                                                                                                   |
|   |  |  |                                                                    |  | <div>Bild:MEPT 3.jpg Auf Sendung mit Frequenzanzeige</div>                                                                                                                                                        |
|   |  |  |                                                                    |  | <div>&lt;/gallery&gt;</div>                                                                                                                                                                                       |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
| - |  |  | [[MEPT CPU]]                                                       |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  | [[MEPT switch module]]                                             |  | [[MEPT switch module]]                                                                                                                                                                                            |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  | <div>Weiter Informationen: <a href="http://www.oe1fm.at/">http://www.oe1fm.at/</a></div>                                                                                                                          |

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## Vielseitige WSPR Bake für mobile und stationäre Anwendungen

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Es dauerte einige Monate - aber jetzt ist es (fast) fertig.

Das Baken Konzept beruht auf getrennten Modulen die nach den speziellen Anforderungen kombiniert werden können.

---

### Anschlüsse:

- **USB interface** für die Windows Konfigurations Software
- **serial interface** zum Anschluss der GPS Maus
- **SPI bus** für die Datenübermittlung zwischen den Modulen
- **ICSP** zum programmieren des PIC Prozessors

---

### Ausstattung:

- Windows Konfigurationssoftware
- Die Bake läuft unabhängig vom PC
- Zeit und geographische Position werden hochgenau aus dem GPS Signal gewonnen
- Unabhängige Generierung des WSPR Datensatz im Mikrocontroller der Bake

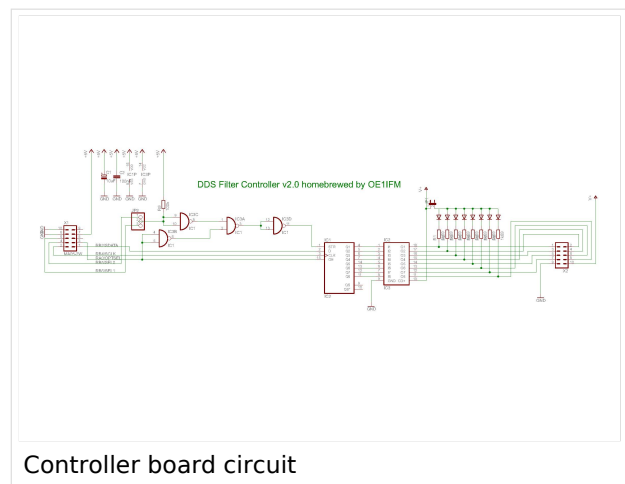
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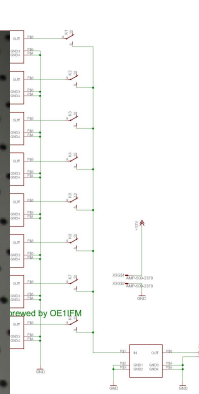
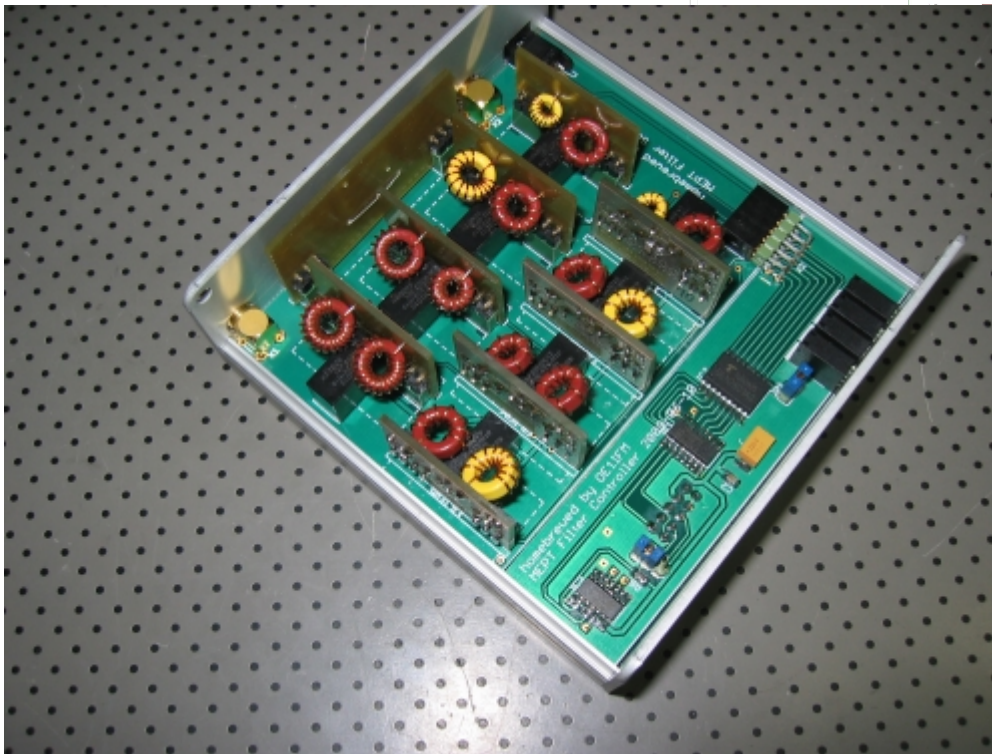
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## MEPT CONFIGURATIONS

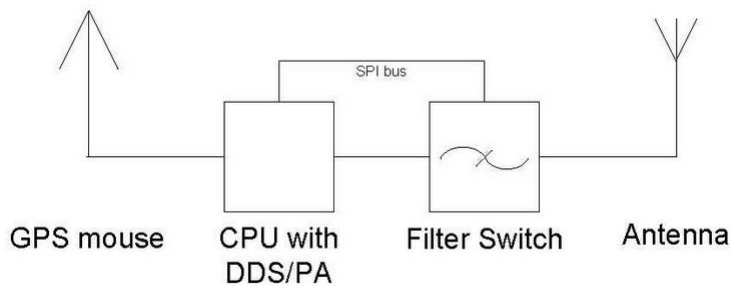
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400px

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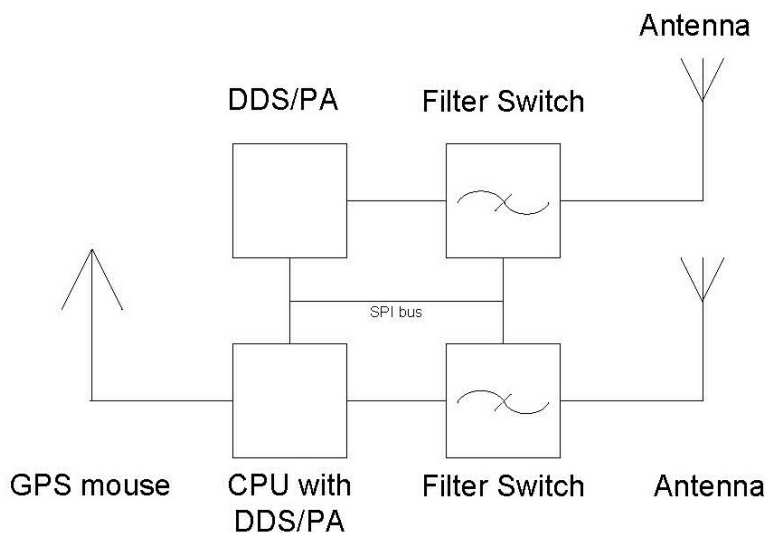
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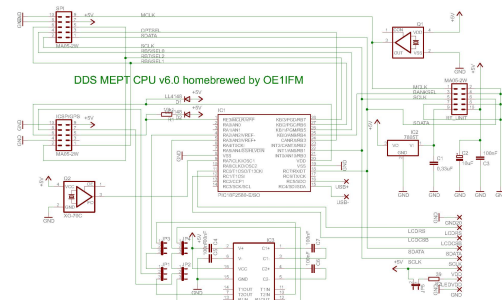
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Main Modul  
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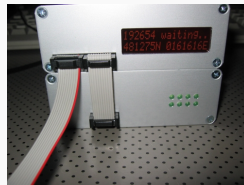
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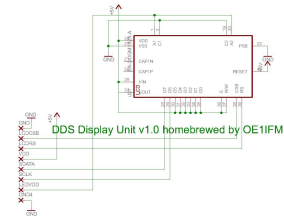
MEPT CPU board circuit



GPS Satelliten Suche



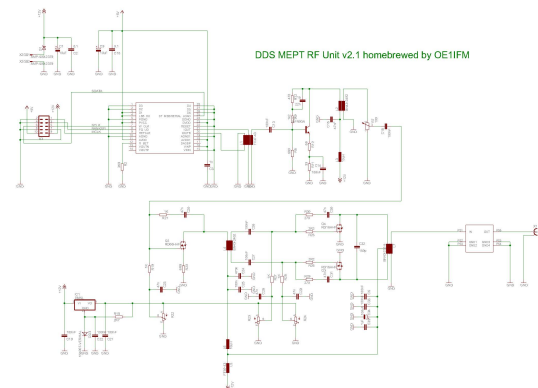
Warten auf  
Sendeslot



MEPT Display board circuit



Auf Sendung mit  
Frequenzanzeige



MEPT DDS & PA board circuit

MEPT switch module

Weiter Informationen: <http://www.oel1fm.at/>

# MEPT - a WSPR beacon: Unterschied zwischen den Versionen

Versionsgeschichte interaktiv durchsuchen  
VisuellWikitext

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|                                                                                                                            |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
| <div>== Connectors: ==</div>                                                                                               |  |  | <div>[[Bild:config1.jpg 400px]]</div>                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                                            |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
| <div>* "USB interface" to connect to a Windows application for configuration</div>                                         |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
| <div>* "serial interface" to attach a GPS mouse</div>                                                                      |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
| <div>* "SPI bus" to interconnect the modules</div>                                                                         |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
| <div>* "ICSP" for in circuit serial programming of the PIC processor</div>                                                 |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                            |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                            |  |  | <div>"Multiband Configuration"</div>                                                                                                                                                                                                                                                                                                                                              |

## == Features: ==

In this setup the filter module in the CPU/PA module is removed and a Filter Switch Module is installed in the signal path. Through the SPI bus the CPU controls the Filter Switch Module. The module can hold up to 8 filter boards, hence enabling the system to transmit on up to eight different bands. Additionally an attenuator module can be installed in the Filter Switch Module allow driving of a non resonant antenna. Again fixed and mobile operation is possible. In mobile applications usually a smaller number of bands will be choosen, optimizing probability to be heard at all.

\* Configuration software for Windows

[[Bild:MEPT Config2.jpg|400px]]

\* Beacon runs independent from PC

\* Time and Location can be derived from GPS signal

\* Autonomous generation of WSPR data string in local microcontroller

\* Up to 8 different filters selectable through filter switch box

\* Up to 4 Attenuator networks selectable through attenuator switch box

\* Multiple DDS & PA modules attachable to one controller

\* DDS & PA module for 1.8-50MHz with up to 15W

'''Multiband Confiquration with Attenuator Switch'''

|   |                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| - | <div>At the moment there are two modules. The CPU box with a DDS/PA module and a switch box that can hold up to 8 filter and one attenuator modules</div> | + | <div>Especially for fixed beacon operation transmission with variable power levels on multiple bands is desired. In this configuration the multiband config is amended by a Attenuator Switch Module. This module can hold up to 4 attenuator boards and is controlled by the CPU through the SPI bus.</div>                                                                                                                                               |
| - | <div>[[Bild:MEPT_2.jpg]]</div>                                                                                                                            | + | <div>[[Bild:config3.jpg 400px]]</div>                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   |                                                                                                                                                           | + | <div>'''Multiband Configuration with Multiple DDS/PA Modules</div>                                                                                                                                                                                                                                                                                                                                                                                         |
|   |                                                                                                                                                           | + | <div>When running the beacon in Multiband config with a filter box with 8 boards installed, one will only reach a TX time of 12,5%. To increase the TX time to 25% (or higher) with still covering 8 bands (or more) additional DDS/PA modules with individual Filter Switch Modules can be driven from a single CPU. These signal sources can be attached to diffent antennas as shown, or through a LPF/HPF signal combiner into a single antenna.</div> |
| - | <div>Here you can find an overview of the possible configurations</div>                                                                                   | + | <div>[[Bild:MEPT Config4.jpg 400px]]</div>                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   |                                                                                                                                                           | + | <div>&lt;br&gt;&lt;br&gt;</div>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| - | <div>[[MEPT CONFIGURATIONS]]</div>                                                                                                                        | + | <div>== MEPT CPU Modul ==</div>                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   |                                                                                                                                                           | + | <div>[[Bild:MEPT DDS CPU v6.0.jpg thumb MEPT CPU board circuit]]</div>                                                                                                                                                                                                                                                                                                                                                                                     |

|   |  |  |  |  |                                                                                                                                                                                                                   |
|---|--|--|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |  |  |  |  | <div>[[Bild:MEPT DDS Displav Unit v1.0.jpg thumb MEPT Display board circuit]]</div>                                                                                                                               |
|   |  |  |  |  | <div>[[Bild:MEPT_DDS RF unit v2.1.jpg thumb MEPT DDS &amp; PA board circuit]]</div>                                                                                                                               |
|   |  |  |  |  |                                                                                                                                                                                                                   |
|   |  |  |  |  | <div>The main module holds the CPU with USB and GPS serial interface, the master oscillator and one DDS with a 15W PA module. It can be run stand alone and accepts one filter module on the RF unit board.</div> |
|   |  |  |  |  |                                                                                                                                                                                                                   |
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|   |  |  |  |  |                                                                                                                                                                                                                   |
|   |  |  |  |  |                                                                                                                                                                                                                   |
|   |  |  |  |  | <div>&lt;gallery&gt;</div>                                                                                                                                                                                        |
|   |  |  |  |  | <div>Bild:MEPT 4.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |  |  |  |  | <div>Bild:MEPT 5.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |  |  |  |  | <div>Bild:MEPT 6.jpg GPS Satelliten Suche</div>                                                                                                                                                                   |
|   |  |  |  |  | <div>Bild:MEPT 7.jpg Warten auf Sendeslot</div>                                                                                                                                                                   |
|   |  |  |  |  | <div>Bild:MEPT 3.jpg Auf Sendung mit Frequenzanzeige</div>                                                                                                                                                        |
|   |  |  |  |  | <div>&lt;/gallery&gt;</div>                                                                                                                                                                                       |
|   |  |  |  |  |                                                                                                                                                                                                                   |
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|   |  |  |  |  |                                                                                                                                                                                                                   |
|   |  |  |  |  |                                                                                                                                                                                                                   |
|   |  |  |  |  | <div>Weiter Informationen: <a href="http://www.oe1i fm.at/">http://www.oe1i fm.at/</a></div>                                                                                                                      |

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## Vielseitige WSPR Bake für mobile und stationäre Anwendungen

---

MEPT = Manned Experimental Propagation Transmitter

Die MEPT **WSPR** Bake sendet für 2 Minuten die **WSPR** Bake und wechselt dann automatisch auf ein anderes Band. Die Zeit und den Locator holt sich die Bake vom angeschlossenen GPS Empfänger. Damit können alle Kurzwellen Amateurfunkbänder und 6m abgedeckt werden. Das Gerät ist kompakt aufgebaut und benötigt für den Betrieb keinen Computer was den Stromverbrauch signifikant senkt.



Es dauerte einige Monate - aber jetzt ist es (fast) fertig.

Das Baken Konzept beruht auf getrennten Modulen die nach den speziellen Anforderungen kombiniert werden können.

---

### Anschlüsse:

---

- **USB interface** für die Windows Konfigurations Software
- **serial interface** zum Anschluss der GPS Maus
- **SPI bus** für die Datenübermittlung zwischen den Modulen
- **ICSP** zum programmieren des PIC Prozessors

---

### Ausstattung:

---

- Windows Konfigurationssoftware
- Die Bake läuft unabhängig vom PC
- Zeit und geographische Position werden hochgenau aus dem GPS Signal gewonnen
- Unabhängige Generierung des WSPR Datensatz im Mikrocontroller der Bake

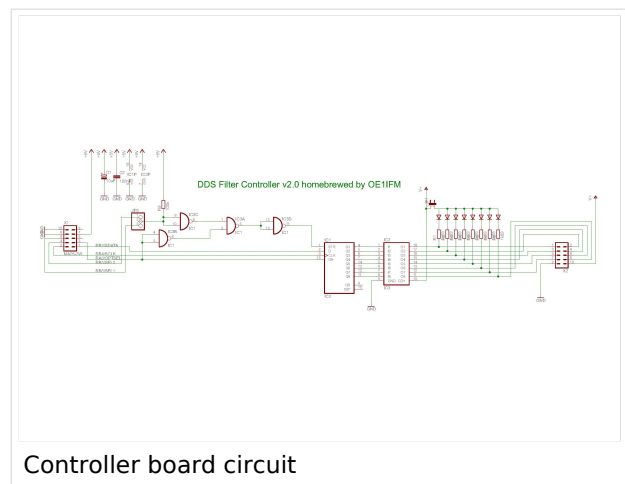
- Bis zu 8 verschiedene Filter über eine Filterschaltbox anwählbar
- Bis zu 4 Dämpfungsglieder Netzwerke durch die Abschwächer Box steuerbar
- Mehrere DDS & PA Module an einem Controller anschließen
- DDS & PA Modul für 1.8-50MHz mit bis zu 15W
- Bänder (160m / 80m / 40m / 30m / 20m/ 17m / 15m / 12m / 10m / 6m)

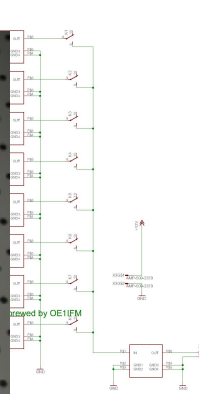
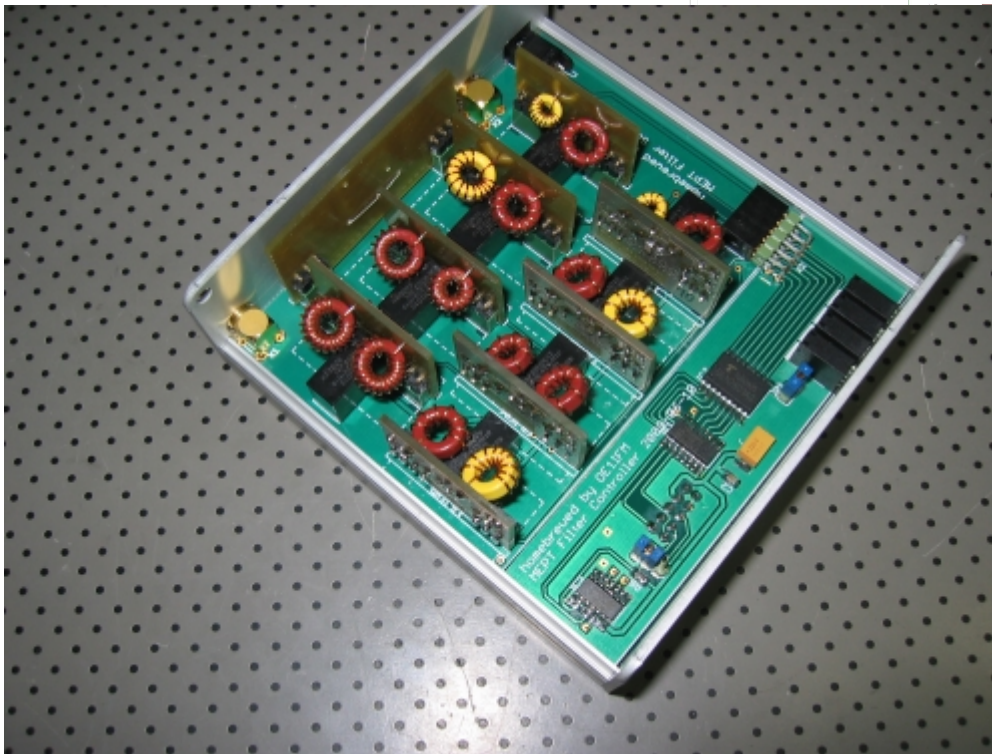
At the moment there are two modules. The CPU box with a DDS/PA module and a switch box that can hold up to 8 filter and one attenuator modules



## MEPT SWITCH Modul

The switch module can hold up to 8 filter or attenuator boards. For bands from 160m to 6m elliptical low pass filters are ready. I am planning a band pass filter for 6m as the local oscillator signals are below the working frequency. When used with filters there is one additional slot that can hold an attenuator for using the system on an unmatched antenna. There will be another switch board with 4 instead of 8 positions that will be able to hold attenuator boards of the same size.





## MEPT CONFIGURATIONS

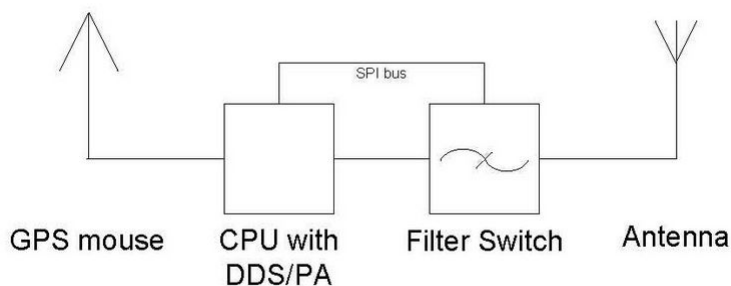
### BASIC Configuration

The beacon system can be configured in various scenarios. The most simple one is the CPU unit with the integrated PA used stand alone. In this setup a LPF filter module is installed within the CPU box. So beaconding is only possible on one band. Either fixed - with pre programmed Locator - or mobile where location information is derived from the GPS signal.

400px

### Multiband Configuration

In this setup the filter module in the CPU/PA module is removed and a Filter Switch Module is installed in the signal path. Through the SPI bus the CPU controls the Filter Switch Module. The module can hold up to 8 filter boards, hence enabling the system to transmit on up to eight different bands. Additionally an attenuator module can be installed in the Filter Switch Module allow driving of a non resonant antenna. Again fixed and mobile operation is possible. In mobile applications usually a smaller number of bands will be choosen, optimizing probability to be heard at all.



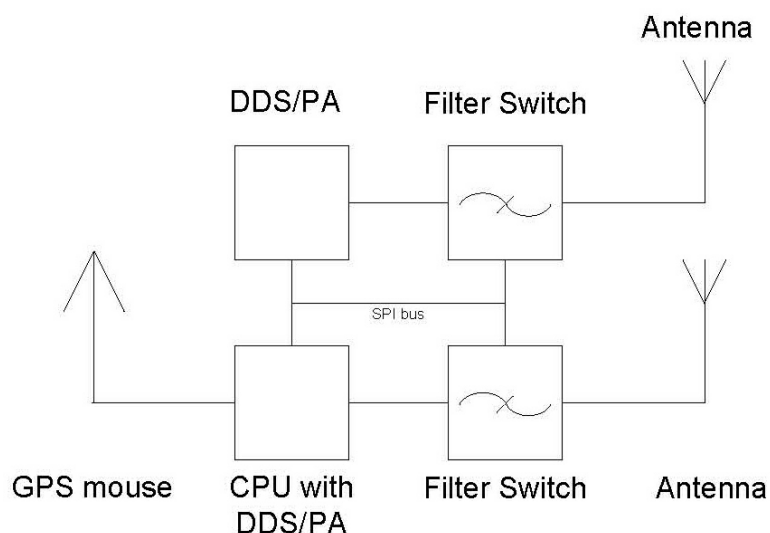
### Multiband Configuration with Attenuator Switch

Especially for fixed beacon operation transmission with variable power levels on multiple bands is desired. In this configuration the multiband config is amended by a Attenuator Switch Module. This module can hold up to 4 attenuator boards and is controlled by the CPU through the SPI bus.

400px

### Multiband Configuration with Multiple DDS/PA Modules

When running the beacon in Multiband config with a filter box with 8 boards installed, one will only reach a TX time of 12,5%. To increase the TX time to 25% (or higher) with still covering 8 bands (or more) additional DDS/PA modules with individual Filter Switch Modules can be driven from a single CPU. These signal sources can be attached to different antennas as shown, or through a LPF/HPF signal combiner into a single antenna.



### MEPT CPU Modul

The main module holds the CPU with USB and GPS serial interface, the master oscillator and one DDS with a 15W PA module. It can be run stand alone and accepts one filter module on the RF unit board.



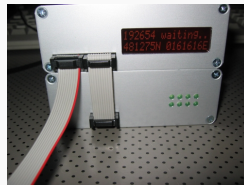
Main Modul  
Innenansicht



Main Modul  
Innenansicht



GPS Satelliten Suche



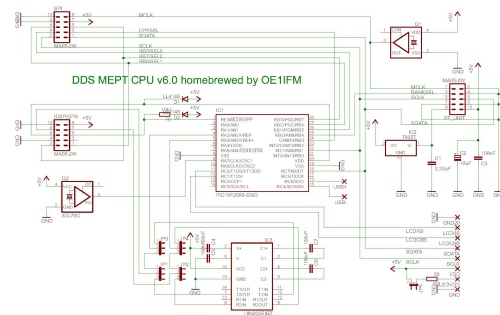
Warten auf  
Sendeslot



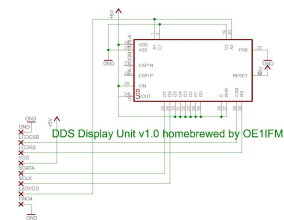
Auf Sendung mit  
Frequenzanzeige

MEPT switch module

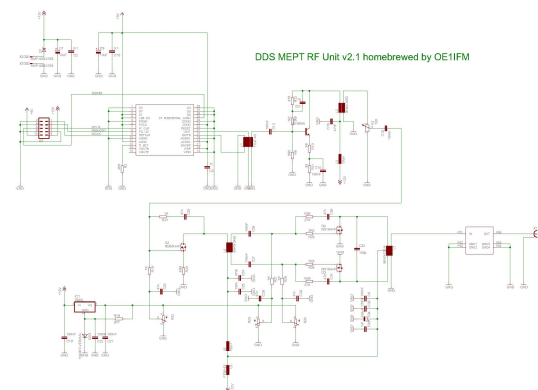
Weiter Informationen: <http://www.oe1ifm.at/>



MEPT CPU board circuit



MEPT Display board circuit



MEPT DDS & PA board circuit

# MEPT - a WSPR beacon: Unterschied zwischen den Versionen

Versionsgeschichte interaktiv durchsuchen  
VisuellWikitext

Version vom 1. Juli 2009, 09:21 Uhr (Quelltext anzeigen)  
Oe1mcu (Diskussion | Beiträge)  
← Zum vorherigen Versionsunterschied

Aktuelle Version vom 1. Juli 2009, 15:48 Uhr (Quelltext anzeigen)  
Oe1mcu (Diskussion | Beiträge)  
(→MEPT SWITCH Module)

(25 dazwischenliegende Versionen desselben Benutzers werden nicht angezeigt)

Zeile 1:

[[Kategorie:Selbstbau]]

[[Kategorie:digitale\_Betriebsarten]]

== VERSATILE WSPR BEACON for MOBILE and FIXED applications ==

Zeile 1:

[[Kategorie:Selbstbau]]

[[Kategorie:digitale\_Betriebsarten]]

== Vielseitige WSPR Bake für mobile und stationäre Anwendungen ==

MEPT = Manned Experimental Propagation Transmitter

Die MEPT [[WSPR]] Bake sendet für 2 Minuten die [[WSPR]] Bake und wechselt dann automatisch auf ein anderes Band. Die Zeit und den Locator holt sich die Bake vom angeschlossenen GPS Empfänger. Damit können alle Kurzwellen Amateurfunkbänder und 6m abgedeckt werden. Das Gerät ist kompakt aufgebaut und benötigt für den Betrieb keinen Computer was den Stromverbrauch signifikant senkt.

[[Bild:MEPT 1.jpg]]

Es dauerte einige Monate - aber jetzt ist es (fast) fertig.

- + **Das Baken Konzept beruht auf getrennten Modulen die nach den speziellen Anforderungen kombiniert werden können.**
- +
- + **== Anschlüsse: ==**
- +
- + **\* "'USB interface'" für die Windows Konfigurations Software**
- + **\* "'serial interface'" zum Anschluss der GPS Maus**
- + **\* "'SPI bus'" für die Datenübermittlung zwischen den Modulen**
- + **\* "'ICSP'" zum programmieren des PIC Prozessors**
- +
- + **== Ausstattung: ==**
- +
- + **\* Windows Konfigurationssoftware**
- + **\* Die Bake läuft unabhängig vom PC**
- + **\* Zeit und geographische Position werden hochgenau aus dem GPS Signal gewonnen**
- + **\* Unabhängige Generierung des WSPR Datensatz im Mikrocontroller der Bake**
- + **\* Bis zu 8 verschiedene Filter über eine Filterschaltbox anwählbar**
- + **\* Bis zu 4 Dämpfungsglieder Netzwerke durch die Abschwächer Box steuerbar**
- + **\* Mehrere DDS & PA Module an einem Controller anschließbar**
- + **\* DDS & PA Modul für 1.8-50MHz mit bis zu 15W**

|   |                                                    |   |                                                                                                                                                                                                                                           |
|---|----------------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                    | + | * Bänder (160m / 80m / 40m / 30m / 20m/ 17m / 15m / 12m / 10m / 6m)                                                                                                                                                                       |
|   |                                                    | + |                                                                                                                                                                                                                                           |
|   |                                                    |   |                                                                                                                                                                                                                                           |
| - | MEPT = Manned Experimental Propagation Transmitter | + |                                                                                                                                                                                                                                           |
|   |                                                    | + | At the moment there are two modules. The CPU box with a DDS/PA module and a switch box that can hold up to 8 filter and one attenuator modules                                                                                            |
|   |                                                    | + |                                                                                                                                                                                                                                           |
|   |                                                    | + | [[Bild:MEPT_2.jpg]]                                                                                                                                                                                                                       |
|   |                                                    | + |                                                                                                                                                                                                                                           |
|   |                                                    | + |                                                                                                                                                                                                                                           |
|   |                                                    | + | == MEPT SWITCH Modul ==                                                                                                                                                                                                                   |
|   |                                                    | + |                                                                                                                                                                                                                                           |
|   |                                                    | + | [[Bild:MEPT DDS Filter Controller v2.0.jpg thumb Controller board circuit]]                                                                                                                                                               |
|   |                                                    | + | [[Bild:MEPT DDS Filter Switch v2.0.jpg thumb Switch board circuit]]                                                                                                                                                                       |
|   |                                                    |   |                                                                                                                                                                                                                                           |
|   |                                                    |   |                                                                                                                                                                                                                                           |
| - | [[Bild:MEPT 1.jpg]] [[Bild:LCD position.jpg]]      | + | The switch module can hold up to 8 filter or attenuator boards. For bands from 160m to 6m elliptical low pass filters are ready. I am planning a band pass filter for 6m as the local oscillator signals are below the working frequency. |
|   |                                                    | + | When used with filters there is one additional slot that can hold an attenuator for using the system on an unmatched antenna.                                                                                                             |

```

graph LR
    A[There will be another switch board with 4 instead of 8 positions that will be able to hold attenuator boards of the same size.] --> B[MEPT CONFIGURATIONS]
    B --> C["BASIC Configuration"]
    C --> D["The beacon system can be configured in various scenarios. The most simple one is the CPU unit with the integrated PA used stand alone. In this setup a LPF filter module is installed within the CPU box. So beaconing is only possible on one band. Either fixed - with pre programmed Locator - or mobile where location information is derived from the GPS signal."]
    D --> E["Connectors: "]
    E --> F["* 'USB interface' to connect to a Windows application for configuration"]
    E --> G["* 'serial interface' to attach a GPS mouse"]
    E --> H["* 'SPI bus' to interconnect the modules"]
    E --> I["* 'ICSP' for in circuit serial programming of the PIC processor"]
    I --> J["Multiband Configuration"]
  
```

There will be another switch board with 4 instead of 8 positions that will be able to hold attenuator boards of the same size.

MEPT CONFIGURATIONS

"BASIC Configuration"

The beacon system can be configured in various scenarios. The most simple one is the CPU unit with the integrated PA used stand alone. In this setup a LPF filter module is installed within the CPU box. So beaconing is only possible on one band. Either fixed - with pre programmed Locator - or mobile where location information is derived from the GPS signal.

Connectors:

- \* "USB interface" to connect to a Windows application for configuration
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- \* "SPI bus" to interconnect the modules
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Multiband Configuration

### == Features: ==

In this setup the filter module in the CPU/PA module is removed and a Filter Switch Module is installed in the signal path. Through the SPI bus the CPU controls the Filter Switch Module. The module can hold up to 8 filter boards, hence enabling the system to transmit on up to eight different bands. Additionally an attenuator module can be installed in the Filter Switch Module allow driving of a non resonant antenna. Again fixed and mobile operation is possible. In mobile applications usually a smaller number of bands will be choosen, optimizing probability to be heard at all.

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\* DDS & PA module for 1.8-50MHz with up to 15W

'''Multiband Confiquration with Attenuator Switch'''

|   |                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| - | <div>[[Bild:MEPT_2.jpg]]</div>                                                                                                                            | + | <div>[[Bild:config3.jpg 400px]]</div>                                                                                                                                                                                                                                                                                                                                                                                                                      |
|   |                                                                                                                                                           | + | <div>'''Multiband Configuration with Multiple DDS/PA Modules</div>                                                                                                                                                                                                                                                                                                                                                                                         |
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| - | <div>Here you can find an overview of the possible configurations</div>                                                                                   | + | <div>[[Bild:MEPT Config4.jpg 400px]]</div>                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   |                                                                                                                                                           | + | <div>&lt;br&gt;&lt;br&gt;</div>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| - | <div>[[MEPT CONFIGURATIONS]]</div>                                                                                                                        | + | <div>== MEPT CPU Modul ==</div>                                                                                                                                                                                                                                                                                                                                                                                                                            |
|   |                                                                                                                                                           | + | <div>[[Bild:MEPT DDS CPU v6.0.jpg thumb MEPT CPU board circuit]]</div>                                                                                                                                                                                                                                                                                                                                                                                     |

|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|---|--|--|--------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |  |  |                                                                    |  | <div>[[Bild:MEPT DDS Displav Unit v1.0.jpg thumb MEPT Display board circuit]]</div>                                                                                                                               |
|   |  |  |                                                                    |  | <div>[[Bild:MEPT_DDS RF unit v2.1.jpg thumb MEPT DDS &amp; PA board circuit]]</div>                                                                                                                               |
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|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
| - |  |  | A detailed description of the individual modules can be found here |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  | <div>&lt;gallery&gt;</div>                                                                                                                                                                                        |
|   |  |  |                                                                    |  | <div>Bild:MEPT 4.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |  |  |                                                                    |  | <div>Bild:MEPT 5.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |  |  |                                                                    |  | <div>Bild:MEPT 6.jpg GPS Satelliten Suche</div>                                                                                                                                                                   |
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|   |  |  |                                                                    |  | <div>&lt;/gallery&gt;</div>                                                                                                                                                                                       |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
| - |  |  | [[MEPT CPU]]                                                       |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  | [[MEPT switch module]]                                             |  | [[MEPT switch module]]                                                                                                                                                                                            |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  |                                                                                                                                                                                                                   |
|   |  |  |                                                                    |  | <div>Weiter Informationen: <a href="http://www.oe1fm.at/">http://www.oe1fm.at/</a></div>                                                                                                                          |

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## Vielseitige WSPR Bake für mobile und stationäre Anwendungen

---

MEPT = Manned Experimental Propagation Transmitter

Die MEPT **WSPR** Bake sendet für 2 Minuten die **WSPR** Bake und wechselt dann automatisch auf ein anderes Band. Die Zeit und den Locator holt sich die Bake vom angeschlossenen GPS Empfänger. Damit können alle Kurzwellen Amateurfunkbänder und 6m abgedeckt werden. Das Gerät ist kompakt aufgebaut und benötigt für den Betrieb keinen Computer was den Stromverbrauch signifikant senkt.



Es dauerte einige Monate - aber jetzt ist es (fast) fertig.

Das Baken Konzept beruht auf getrennten Modulen die nach den speziellen Anforderungen kombiniert werden können.

---

### Anschlüsse:

- **USB interface** für die Windows Konfigurations Software
- **serial interface** zum Anschluss der GPS Maus
- **SPI bus** für die Datenübermittlung zwischen den Modulen
- **ICSP** zum programmieren des PIC Prozessors

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### Ausstattung:

- Windows Konfigurationssoftware
- Die Bake läuft unabhängig vom PC
- Zeit und geographische Position werden hochgenau aus dem GPS Signal gewonnen
- Unabhängige Generierung des WSPR Datensatz im Mikrocontroller der Bake

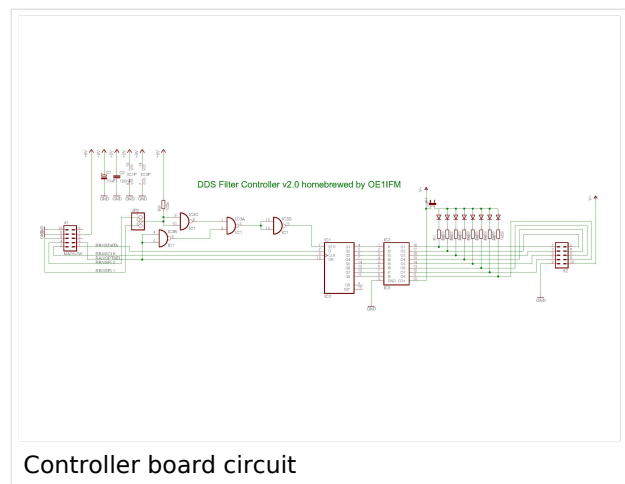
- Bis zu 8 verschiedene Filter über eine Filterschaltbox anwählbar
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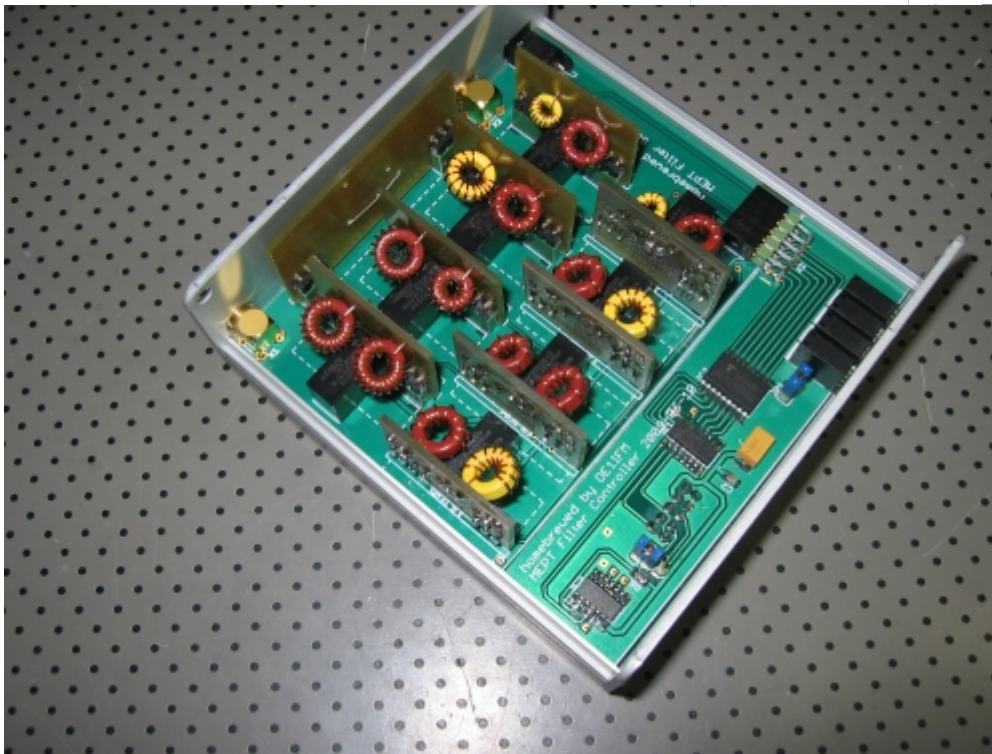
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## MEPT CONFIGURATIONS

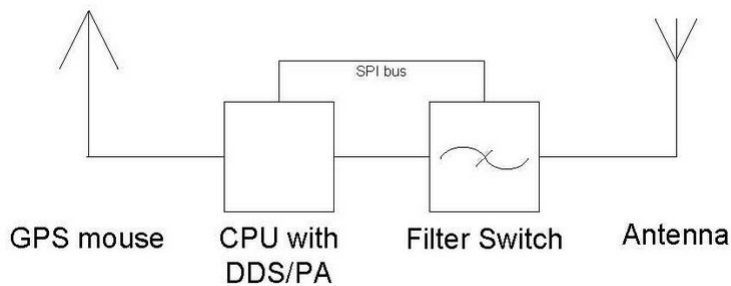
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400px

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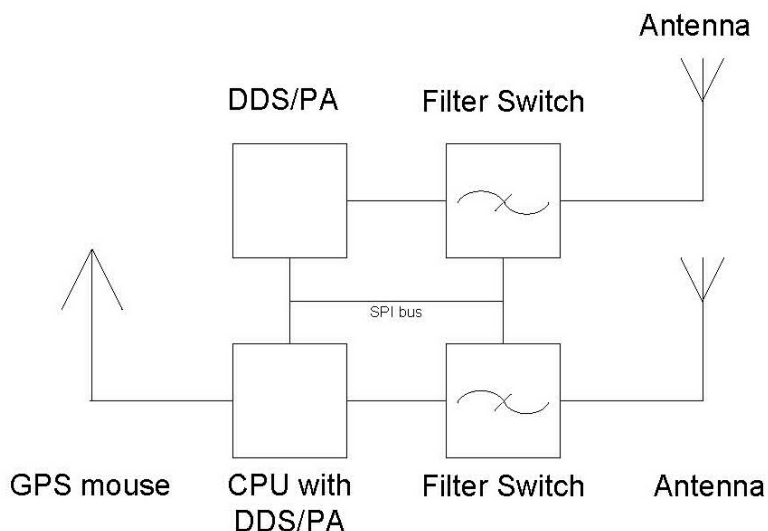
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Main Modul  
Innenansicht



Main Modul  
Innenansicht



GPS Satelliten Suche



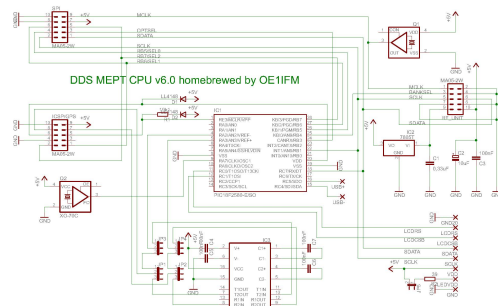
Warten auf  
Sendeslot



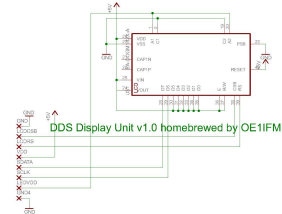
Auf Sendung mit  
Frequenzanzeige

MEPT switch module

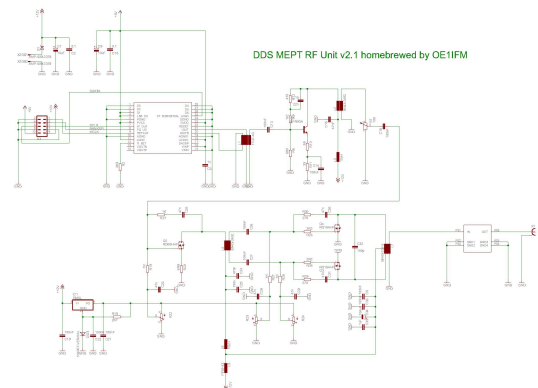
Weiter Informationen: <http://www.oel1fm.at/>



MEPT CPU board circuit



MEPT Display board circuit



MEPT DDS & PA board circuit

# MEPT - a WSPR beacon: Unterschied zwischen den Versionen

Versionsgeschichte interaktiv durchsuchen  
VisuellWikitext

Version vom 1. Juli 2009, 09:21 Uhr (Quelltext anzeigen)  
Oe1mcu (Diskussion | Beiträge)  
← Zum vorherigen Versionsunterschied

Aktuelle Version vom 1. Juli 2009, 15:48 Uhr (Quelltext anzeigen)  
Oe1mcu (Diskussion | Beiträge)  
(→MEPT SWITCH Module)

(25 dazwischenliegende Versionen desselben Benutzers werden nicht angezeigt)

Zeile 1:

[[Kategorie:Selbstbau]]

[[Kategorie:digitale\_Betriebsarten]]

== VERSATILE WSPR BEACON for MOBILE and FIXED applications ==

Zeile 1:

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[[Bild:MEPT 1.jpg]]

Es dauerte einige Monate - aber jetzt ist es (fast) fertig.

- + **Das Baken Konzept beruht auf getrennten Modulen die nach den speziellen Anforderungen kombiniert werden können.**
- +
- + **== Anschlüsse: ==**
- +
- + **\* "'USB interface'" für die Windows Konfigurations Software**
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- +
- + **== Ausstattung: ==**
- +
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|                                                      |  |                                                                                                                                                                                                                                             |
|------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                      |  | + * Bänder (160m / 80m / 40m / 30m / 20m/ 17m / 15m / 12m / 10m / 6m)                                                                                                                                                                       |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  |                                                                                                                                                                                                                                             |
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|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | + [[Bild:MEPT_2.jpg]]                                                                                                                                                                                                                       |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | + == MEPT SWITCH Modul ==                                                                                                                                                                                                                   |
|                                                      |  | +                                                                                                                                                                                                                                           |
|                                                      |  | + [[Bild:MEPT DDS Filter Controller v2.0.jpg thumb Controller board circuit]]                                                                                                                                                               |
|                                                      |  | + [[Bild:MEPT DDS Filter Switch v2.0.jpg thumb Switch board circuit]]                                                                                                                                                                       |
|                                                      |  |                                                                                                                                                                                                                                             |
|                                                      |  |                                                                                                                                                                                                                                             |
| - [[Bild:MEPT 1.jpg]] [[Bild:LCD position.jpg]]      |  | + The switch module can hold up to 8 filter or attenuator boards. For bands from 160m to 6m elliptical low pass filters are ready. I am planning a band pass filter for 6m as the local oscillator signals are below the working frequency. |
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|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|---|-----------------------------------------------------------------------------------------------------------------|--|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                                                                 |  |  |  | There will be another switch board with 4 instead of 8 positions that will be able to hold attenuator boards of the same size.                                                                                                                                                                                                                                         |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  | [[Bild:MEPT 8.jpg]]                                                                                                                                                                                                                                                                                                                                                    |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  | == MEPT CONFIGURATIONS ==                                                                                                                                                                                                                                                                                                                                              |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | It took me a couple of month - but now it's (almost) ready.                                                     |  |  |  | ""BASIC Configuration""                                                                                                                                                                                                                                                                                                                                                |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | A versatile beacon concept that consists of a number modules that can be combined according to the application. |  |  |  | The beacon system can be configured in various scenarios. The most simple one is the CPU unit with the integrated PA used stand alone. In this setup a LPF filter module is installed within the CPU box. So beaconing is only possible on one band. Either fixed - with pre programmed Locator - or mobile where location information is derived from the GPS signal. |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | == Connectors: ==                                                                                               |  |  |  | [[Bild:config1.jpg 400px]]                                                                                                                                                                                                                                                                                                                                             |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""USB interface"" to connect to a Windows application for configuration                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""serial interface"" to attach a GPS mouse                                                                    |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""SPI bus"" to interconnect the modules                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
| - | * ""ICSP"" for in circuit serial programming of the PIC processor                                               |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                 |  |  |  | ""Multiband Configuration""                                                                                                                                                                                                                                                                                                                                            |

### == Features: ==

In this setup the filter module in the CPU/PA module is removed and a Filter Switch Module is installed in the signal path. Through the SPI bus the CPU controls the Filter Switch Module. The module can hold up to 8 filter boards, hence enabling the system to transmit on up to eight different bands. Additionally an attenuator module can be installed in the Filter Switch Module allow driving of a non resonant antenna. Again fixed and mobile operation is possible. In mobile applications usually a smaller number of bands will be choosen, optimizing probability to be heard at all.

\* Configuration software for Windows

[[Bild:MEPT Config2.jpg|400px]]

\* Beacon runs independent from PC

\* Time and Location can be derived from GPS signal

\* Autonomous generation of WSPR data string in local microcontroller

\* Up to 8 different filters selectable through filter switch box

\* Up to 4 Attenuator networks selectable through attenuator switch box

\* Multiple DDS & PA modules attachable to one controller

\* DDS & PA module for 1.8-50MHz with up to 15W

'''Multiband Confiquration with Attenuator Switch'''

|   |                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| - | <p>At the moment there are two modules. The CPU box with a DDS/PA module and a switch box that can hold up to 8 filter and one attenuator modules</p> | + | <p>Especially for fixed beacon operation transmission with variable power levels on multiple bands is desired. In this configuration the multiband config is amended by a Attenuator Switch Module. This module can hold up to 4 attenuator boards and is controlled by the CPU through the SPI bus.</p>                                                                                                                                                 |
| - | <p>[[Bild:MEPT_2.jpg]]</p>                                                                                                                            | + | <p>[[Bild:config3.jpg 400px]]</p>                                                                                                                                                                                                                                                                                                                                                                                                                        |
|   |                                                                                                                                                       | + | <p>'''Multiband Configuration with Multiple DDS/PA Modules</p>                                                                                                                                                                                                                                                                                                                                                                                           |
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| - | <p>Here you can find an overview of the possible configurations</p>                                                                                   | + | <p>[[Bild:MEPT Config4.jpg 400px]]</p>                                                                                                                                                                                                                                                                                                                                                                                                                   |
|   |                                                                                                                                                       | + | <p>&lt;br&gt;&lt;br&gt;</p>                                                                                                                                                                                                                                                                                                                                                                                                                              |
| - | <p>[[MEPT CONFIGURATIONS]]</p>                                                                                                                        | + | <p>== MEPT CPU Modul ==</p>                                                                                                                                                                                                                                                                                                                                                                                                                              |
|   |                                                                                                                                                       | + | <p>[[Bild:MEPT DDS CPU v6.0.jpg thumb MEPT CPU board circuit]]</p>                                                                                                                                                                                                                                                                                                                                                                                       |

|   |                                                                    |  |                                                                                                                                                                                                                   |
|---|--------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                    |  | <div>[[Bild:MEPT DDS Displav Unit v1.0.jpg thumb MEPT Display board circuit]]</div>                                                                                                                               |
|   |                                                                    |  | <div>[[Bild:MEPT_DDS RF unit v2.1.jpg thumb MEPT DDS &amp; PA board circuit]]</div>                                                                                                                               |
|   |                                                                    |  |                                                                                                                                                                                                                   |
|   |                                                                    |  | <div>The main module holds the CPU with USB and GPS serial interface, the master oscillator and one DDS with a 15W PA module. It can be run stand alone and accepts one filter module on the RF unit board.</div> |
|   |                                                                    |  |                                                                                                                                                                                                                   |
| - | A detailed description of the individual modules can be found here |  |                                                                                                                                                                                                                   |
|   |                                                                    |  |                                                                                                                                                                                                                   |
|   |                                                                    |  | <div>&lt;gallery&gt;</div>                                                                                                                                                                                        |
|   |                                                                    |  | <div>Bild:MEPT 4.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |                                                                    |  | <div>Bild:MEPT 5.jpg Main Modul Innenansicht</div>                                                                                                                                                                |
|   |                                                                    |  | <div>Bild:MEPT 6.jpg GPS Satelliten Suche</div>                                                                                                                                                                   |
|   |                                                                    |  | <div>Bild:MEPT 7.jpg Warten auf Sendeslot</div>                                                                                                                                                                   |
|   |                                                                    |  | <div>Bild:MEPT 3.jpg Auf Sendung mit Frequenzanzeige</div>                                                                                                                                                        |
|   |                                                                    |  | <div>&lt;/gallery&gt;</div>                                                                                                                                                                                       |
|   |                                                                    |  |                                                                                                                                                                                                                   |
| - | [[MEPT CPU]]                                                       |  |                                                                                                                                                                                                                   |
|   |                                                                    |  |                                                                                                                                                                                                                   |
|   | [[MEPT switch module]]                                             |  | [[MEPT switch module]]                                                                                                                                                                                            |
|   |                                                                    |  |                                                                                                                                                                                                                   |
|   |                                                                    |  |                                                                                                                                                                                                                   |
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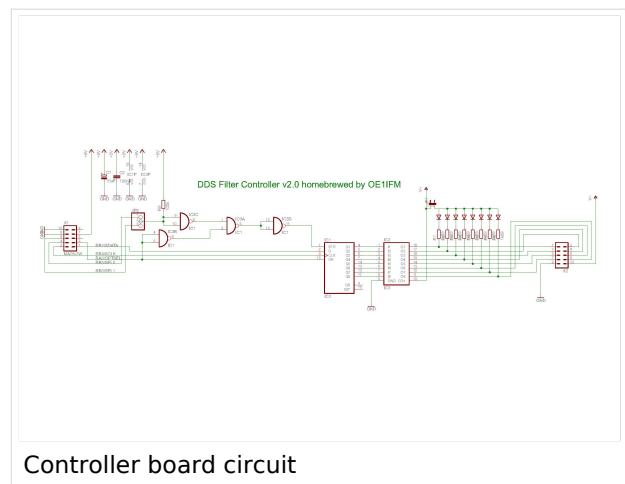
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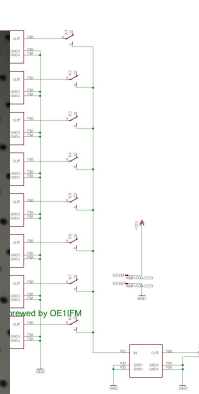
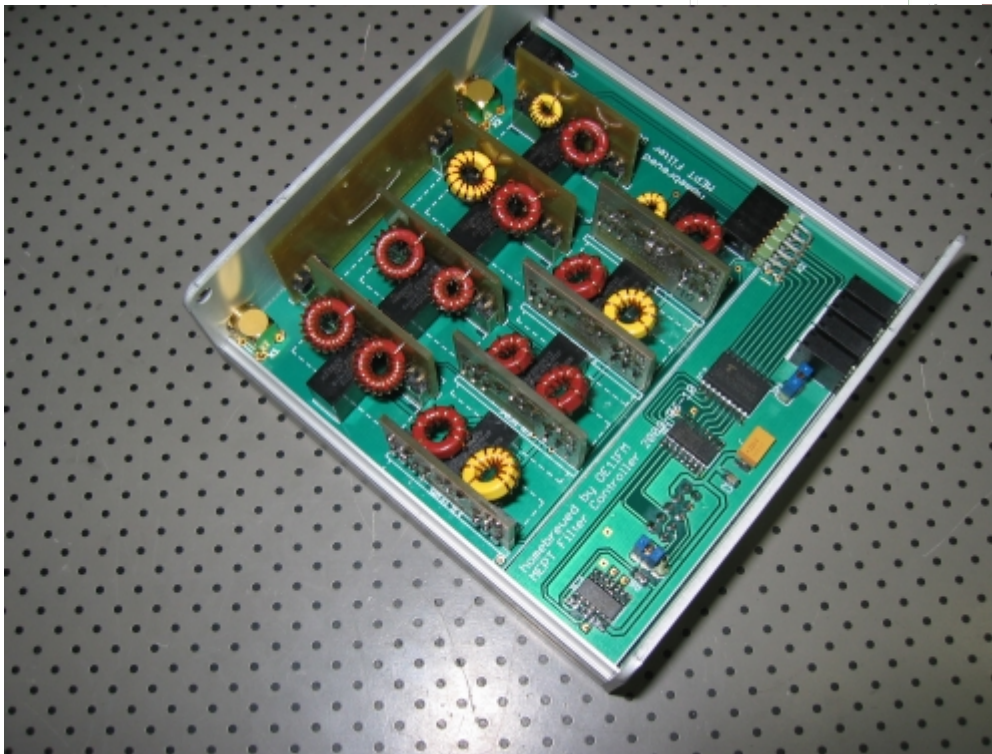
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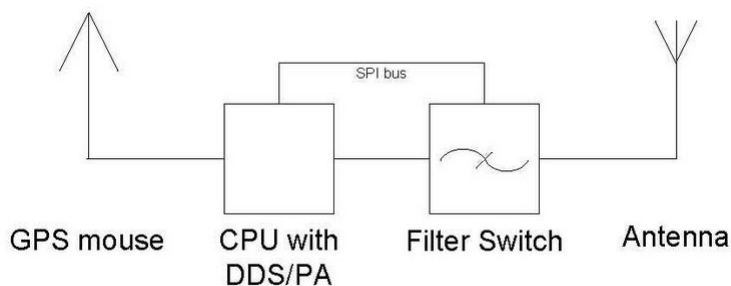
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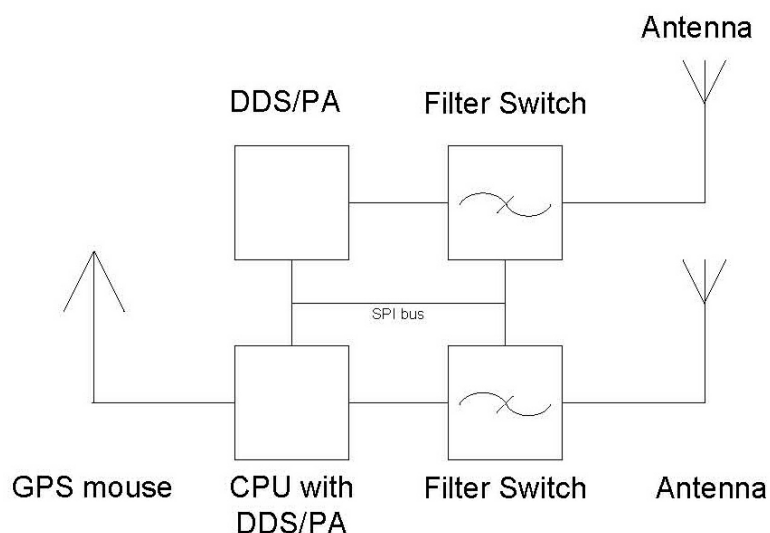
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GPS Satelliten Suche



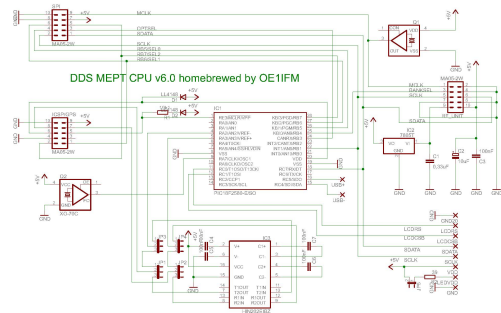
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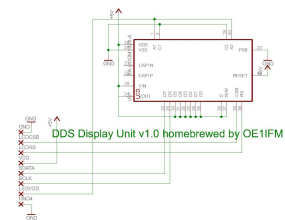
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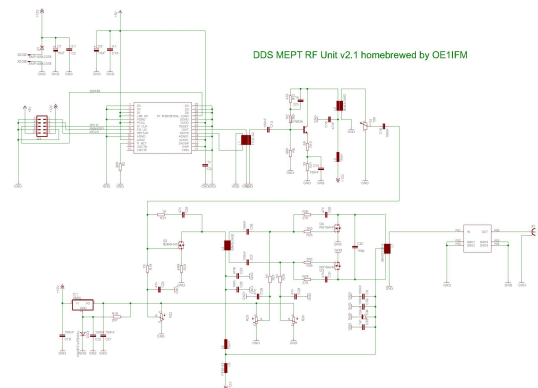
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MEPT CPU board circuit



MEPT Display board circuit



MEPT DDS & PA board circuit