

P60 Prototyping Board User's Guide

This document describes the use of the P60 in an effort to help users set up the board electrically and mechanically and to learn how to communicate to it. The document does not explain all functionality provided by the M68 module. For more information, see the M68/M64 Module Data Sheet.

KEY POINTS

- Evaluation kit and prototyping board for the M64/M68 IEEE 1588 modules
- Provides full access to the features and capabilities of the M68
- Based on the M68 module, which is a superset of the M64

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1. Scope

This document covers the P60, carrying a M68 module running v2.9.19 or later. For more information about the P60, see [17. References](#).

2. General Description

The P60 is an evaluation board for the M64 and M68 modules, which makes it possible to control and monitor all functionality provided by these modules. The board is powered through a single 5 V power supply or over USB. It provides two Ethernet interfaces for communication to the network, including PTP. One with copper RJ45 and one with SFP. It has a USB port for serial communication and SMA connectors for PPSIN, PPSOUT, FREQOUT, TODIN and TODOUT. The board has a high quality TCVCXO mounted.

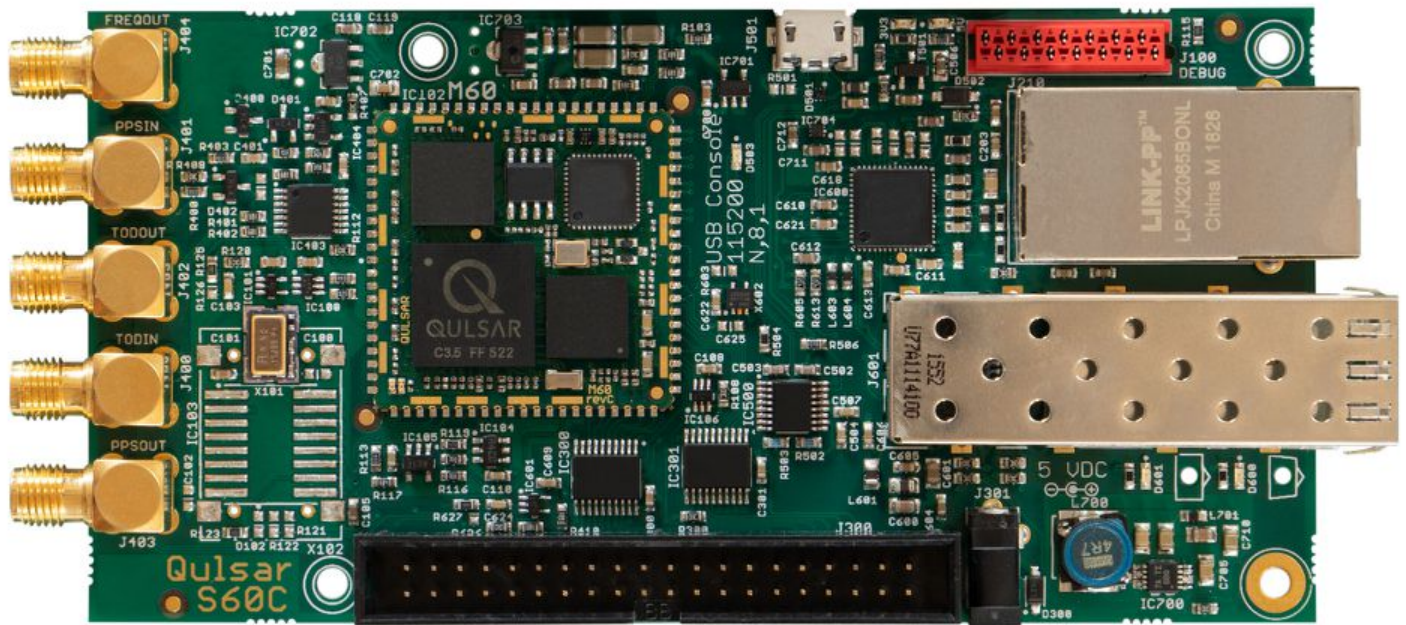


Figure 2.1. P60

3. Before You Begin

You need the following to use the board:

- Power supply 5 V, 1 A – If not powered over USB, not included
- Ethernet cables (SFP and fiber if you intend to use optical communication) – not included
- SMA cables – not included
- USB cable - not included
- A PC with a terminal program such as TeraTerm or PuTTY – not included

4. Power

The P60 only needs a single 5 V supply. It has regulators to provide all necessary voltages for the components on the P60. Two green LED indicate 5 and 3.3 V on the P60 that should be lit when powered properly.

5. Block Diagram

The block diagram below shows the connections on the P60.

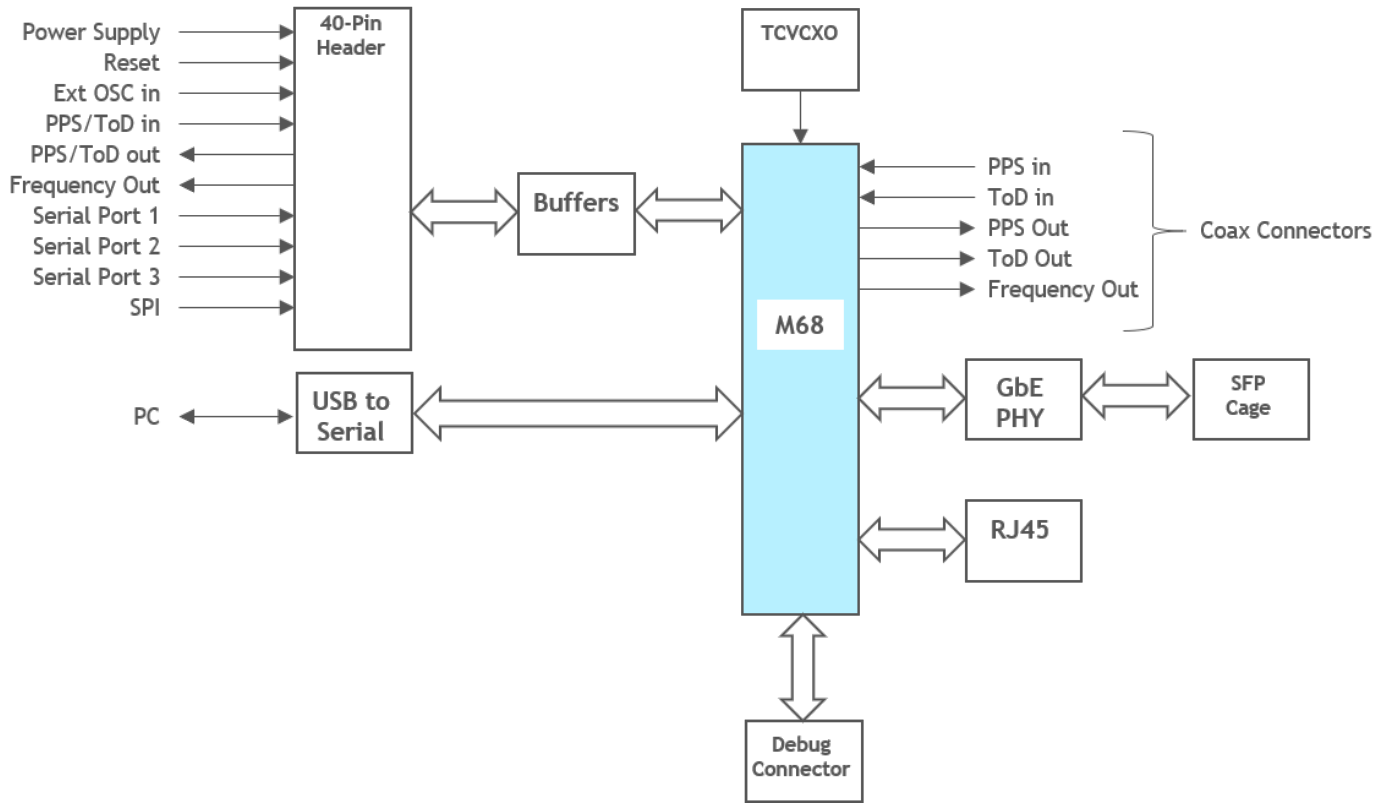


Figure 5.1. P60 Block Diagram

6. Connectors

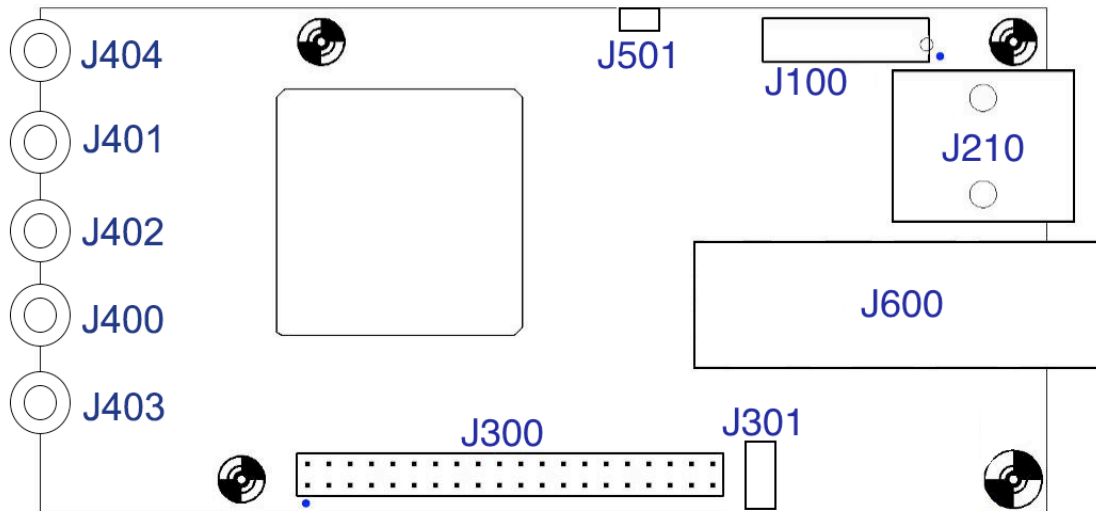


Figure 6.1. P60 Connector Placement

Table 6.1. P60 Connector Descriptions

Name	Type	Description
J300	40-pin header, 2.54 mm pitch	Peripheral interface
J600	SFP jack	Secondary Ethernet
J201	RJ-45 jack	Primary Ethernet
J100	14-pin Micro-Match female	Power, Serial Interface and Debug
J400	SMA female	ToD in
J401	SMA female	PPS in
J402	SMA female	ToD out
J403	SMA female	PPS out 50 Ω
J404	SMA female	Frequency out
J301	4.4 mm (EIAJ-2) DC jack	Optional power
J501	Micro USB	Power and serial interface

6.1 Peripheral Interface

J300 contains all the necessary power connections plus buffered connections to all the M68's peripheral interfaces. The buffered PTP signals available at SMA connectors J400-J404 are also available here. J300 is in normal cases sufficient for connection to a host system.

Table 6.2. J300 Pin Description

Pin	Signal	Comment
1	VBAT	Backup battery input
2	TODIN	Time of Day input
3	PPSIN	PPS from GPS receiver
4	TODOUT	Time of Day output
5	PPSOUT	Pulse per second output (pulse train)
6	MIRQ1	External interrupt input (unbuffered)
7	5V	Alternative supply voltage 5 V. Protected by diode if supplied from USB console
8	OSCSEL	Select external/on-board oscillator. Set high to use external oscillator, low or unconnected to use on-board oscillator
9	GND	Ground
10	MCKOUT1	Subdivision of oscillator frequency (unbuffered)
11	GND	Ground
12	SYNTHFREQ	Syntonized frequency output
13	GND	Ground
14	FREQOUT	Syntonized frequency output (5/10/20/25 MHz)
15	GND	Ground
16	EXTOSC	External oscillator input (20 MHz)
17	GND	Ground
18	Reserved	Reserved
19	GND	Ground
20	Reserved	Reserved
21	Reserved	Reserved
22	RESET	Active low reset input (unbuffered)
23	3V3	Supply voltage 3.3 V
24	PJ0_UTX1	Port J bit 0 / Serial port 1 TX. Buffered, output only
25	PJ1_URX1	Port J bit 1 / Serial port 1 RX. Buffered, input only
26	PJ2_URTS1	Port J bit 2 / Serial port 1 RTS. Buffered, output only
27	PJ3_UCTS1	Port J bit 3 / Serial port 1 CTS. Buffered, input only

Pin	Signal	Comment
28	PE0_UTX2	Port E bit 0 / Serial port 2 TX. Buffered, output only
29	PE1_URX2	Port E bit 1 / Serial port 2 RX. Buffered, input only
30	PE2_URTS2	Port E bit 2 / Serial port 2 RTS. Buffered, output only
31	PE3_UCTS2	Port E bit 3 / Serial port 2 CTS. Buffered, input only
32	PE4_UTX3	Port E bit 4 / Serial port 3 TX. Buffered, output only
33	PE5_URX3	Port E bit 5 / Serial port 3 RX. Buffered, input only
34	PE6_URTS3	Port E bit 6 / Serial port 3 RTS. Buffered, output only
35	PE7_UCTS3	Port E bit 7 / Serial port 3 CTS. Buffered, input only
36	Reserved	Reserved
37	GND	Ground
38	EN_3V3	Enable 3.3V input. Tie low if 3.3V is supplied via this connector, otherwise, leave unconnected
39	3V3	Supply voltage 3.3 V
40	AOUT1	Voltage control for external oscillator

6.2 Ethernet Connection

A Gigabit Ethernet port is available on RJ45 J210 and a secondary Ethernet port is available on SFP J600. The link/activity and speed LEDs for the port are placed on the PCB.

6.3 Serial Ports and USB Console

Three serial ports, COM1, COM2, and COM3 are available in J300, all with LVTTTL signal levels but buffered to 5 V tolerance.

All three serial ports have hardware flow control lines RTS/CTS; none have DTR/DSR, RI or CD lines. The baud rate of the serial ports is limited to 921.6 Kbit/s.

The signals associated with the serial ports are available in the peripheral interface connector J300. All of them can be used as General Purpose Input/Output (GPIO), if the corresponding port is not used. However, since the signals are all buffered, the direction of each signal is fixed.

COM3 is the default port for communication with the M68. The on-board USB to Serial adapter is also connected to COM3.

6.4 Clocking and Timing Signals

An input for an external oscillator (EXTOSC) is available for use in applications requiring higher oscillator stability than that offered by the on-board oscillator. Selection between on-board and an external oscillator is made using the OSCSEL input. Tie OSCSEL high to use an external oscillator, leave it open or tie it low to use the on-board oscillator.

The AOUT1 analog output should be used to control an external oscillator with voltage-controlled frequency.

An input for a PPS signal is also available for connection to a GPS receiver in a grandmaster application. There is a ToD (Time of Day) input that can accept NMEA or China Mobile data from the GPS or from other sources. ToD can also be input via one of the serial ports in a window between PPS pulses.

Two precise synchronized output signals are generated from the synchronized PTP clock. One is the frequency output (FREQOUT) that can be 5/10/20/25 MHz, and the other is a configurable time signal output (PPSOUT) usually used to produce a PPS output signal.

The frequency of the FREQOUT output is selected by software. By default, SYNTHFREQ and FREQOUT are set to the same frequency for backwards compatibility.

The ToD information related to the PPS output is normally output on the TODOUT signal in NMEA or China Mobile format. It can also be output on any of the serial ports.

If a fixed-frequency external oscillator is used, the frequency output signal FREQOUT or SYNTHFREQ will not be synchronized. However, in this case, the PPS output will still be synchronized to the PTP clock.

All the signals mentioned previously are available in the 40-pin peripheral interface connector J300. PPSIN, TODIN, PPSOUT, TODOUT and FREQOUT are also available on separate SMA coaxial connectors J400-J404 for easy connection of measurement instruments, and for using the P60 stand-alone.

6.5 Reset

The system can be reset with the reset line in peripheral connector J300. The M68 module also uses the microcontroller's integrated Power-on Reset circuit to ensure proper power-on/off/brownout reset.

7. On-board Oscillator

The P60 is delivered with a precision 20 MHz TCVCXO mounted, either a Murata XTCLH20M000CYJB6P0 or an IQD CFPT-125TS 20 MHz.

8. Powering the P60

Power can be supplied to the P60 in several ways:

1. From the Host over J300. When attached to a host system, the P60 usually draws its power from the host system (usually 3.3 V). The host must signal if it supplies 3.3 V by tying the EN_3V3 signal low. The host can optionally power the P60 with unregulated 5 V, taking advantage of the P60's on-board switching regulator. In this case, EN_3V3 shall be left open.
2. From the USB Console. The P60 can be powered by connecting the J501 to a USB port of a PC (or a powered USB hub). This will also provide a serial port to the PC. Please note that the USB port of the PC (or the hub) needs to be able to provide adequate power. See DC and AC Electrical Characteristics.
3. Using P300. For the case when the P60 is operating in stand-alone or the power provided by the USB port is not adequate, an unregulated 5V DC jack is provided. The USB console can also be attached without either consuming or supplying current from or to the host. Diodes on the P60 prevent it.

9. Connecting to the Board

1. After powering the system, connect one end of the USB cable to the P60 and the other end to your computer. After connecting to the PC, the "Found New Hardware Wizard" will appear on the PC. Allow the wizard to install the USB driver automatically.
2. Verify which communication port is assigned to the USB serial port by checking the Device Manager. You will need this information to configure the serial port being used.
3. Open your terminal program application and connect it to the serial port using a baud rate of 115200, 8 bit data, no parity, 1 stop bit and no flow control.
4. When you hit enter, you should see the following:

```
localhost.localdomain (M68, v2.9.15)
Login:
```

5. Use the following credentials to log in:

```
Login: root
Password: root
```

10. Connecting to the Network

Using an ordinary switch, connect J210 of the P60 to your network. If the network supports DHCP, you do not need to do anything to get network connection. Check network status with ipconfig.

11. Configure the PTP Engine

Depending on whether the on-board TCXO or an external oscillator is used, the voltage control range needs to be set to the appropriate value.

When using internal TCXO (default):

```
ptp2 config -v 6000
```

Note: This setting needs to be done before the PTP engine is started to have an effect.

12. Setting up P60 as PTP Grand Master

12.1 Connecting PPS and TOD

Connect PPS and TOD from a time source such as a GNSS receiver to the P60.

12.2 Start the PTP Engine

Start the PTP engine in mode 1, just type `ptp2 start` or `ptp2 start 1`.

12.3 Check GNSS Reception on the M68

After starting the PTP engine, give the following commands to check the status.

```
ptp2 gps status (this will show GPS interface status)
```

```
ptp2 gps nmea (this will show satellite information)
```

12.4 Set up PTP Communication

By default, the P60 runs PTP in multicast over IPv4 using E2E delay mechanism. Sync messages are one-step and the rate is 1/s. Delay request rate is 1/s and Announce rate 1/2s. If you want to change any of these parameters, see [17. References](#).

13. Setting up P60 as an E2E, Multicast PTP Slave

This section shows how to configure the P60 as slave with a known master in a multicast application.

13.1 Setting up the P60

1. Connect J210 of the P60 to the master clock and a network with DHCP (if DHCP is not available, see the command `ipconfig` on how to assign an IPV4 address to `enet0`).
2. Make sure the P60 has a link (J210 refers to `enet0` and J600 to `enet1`).

```
A:/root> ipconfig enet0
Interface "enet0":
Ip address      169.254.144.153 (DHCP)
Netmask        255.255.0.0
Gateway        N/A
MAC:           fc:af:6a:02:52:15
Link state:    1000M/Full

Primary DNS    N/A
Secondary DNS  N/A
DNS timeout    10
Mailhost       N/A
```

3. Start the PTP engine on the P60 in mode 0.

```
A:/root> ptp2 start 0
PTP Time: 2019-02-15 13:24:40
UTC Offset: 37 s
*** PTPv2 up and running ***
```

4. Wait for the following message to appear.

```
A new master time is received or the network topology was changed.
Update local clock with new offset: sec: -0 nsec: 866271987
```

See [17. References](#) for commands on how to further control and monitor the PTP communication.

14. Setting up P60 as an E2E, Unicast PTP Slave

This section shows how to configure the P60 as slave with a known master in a Unicast application.

14.1 Setting up the P60

1. Connect J210 of the P60 to the master directly or through a switch.
2. Either use DHCP or set an IP address and mask for the same subnet as the master.

```
ipconfig enet0 -a 192.168.2.101 -m 255.255.255.0
```

3. Make sure the P60 has a link (J210 refers to enet0 and J600 to enet1)

```
A:/root> ipconfig enet0
Interface "enet0":
Ip address      192.168.2.101
Netmask        255.255.255.0
Gateway        N/A
MAC:           fc:af:6a:02:52:15
Link state:    1000M/Full

Primary DNS    N/A
Secondary DNS  N/A
DNS timeout    10
Mailhost       N/A
```

4. Verify the network connection by pinging the master.

```
A:/root> ping 192.168.2.100
Pinging 192.168.2.100 (192.168.2.100)
Reply from 192.168.2.100: bytes=72, time<10ms
Reply from 192.168.2.100: bytes=72, time<10ms
Reply from 192.168.2.100: bytes=72, time<10ms
Reply from 192.168.2.100: bytes=72, time<10ms
```

5. Start the PTP engine on the P60 in mode 0

```
A:/root> ptp2 start 0
PTP Time: 2019-02-15 13:24:40
UTC Offset: 37 s
*** PTPv2 up and running ***
```

6. Set enet0 to Unicast Slave

```
A:/root> ptp2 port 1 unicast slave
A:/root> Unicast port state: PTP2_STATE_SLAVE
```

7. Add the master to the list of accepted masters

```
A:/root> ptp2 unicast 1 node add 192.168.2.100 0 0 0
A:/root> *** Unicast node dataset ***
{
  Clock identity: FF:FF:FF:FF:FF:FF:FF:FF
  Network protocol: UDP/IPv4
  Network address: 192.168.2.100
  Node type: MASTER
  Announce granted: FALSE
  Announce interval: 1
  Announce duration: 300
  Sync granted: FALSE
  Sync interval: 0
  Sync duration: 0
  Delay response granted: FALSE
  Delay response interval: 0
  Delay response duration: 0
  Local priority: 0
}
```

8. Wait for the following message to appear

```
A new master time is received or the network topology was changed.
Update local clock with new offset: sec: -0 nsec: 866271987
```

See [17. References](#) for commands on how to further control and monitor the PTP communication.

15. Using the PTP Engine

Detailed information about how to interact with the PTP engine can be found in [17. References](#), which can be downloaded from our web site.

Any commands that the P60 should execute at startup, such as setting message rates etc. can be stored in the startup.ini file under the systems folder.

Using the serial port, the startup.ini file can be transferred to your PC using the kermit `-s <filename>` command, edited on your PC and then downloaded to the P60 again using kermit `-r`. Alternatively, FTP can be used over the network to upload the startup.ini file, edit the contents of the file, and then download to the systems folder.

16. Updating Firmware on P60

See [17. References](#) on various ways to update the FW on the P60.

17. References

1. M68/M64 Module Data Sheet

Contact

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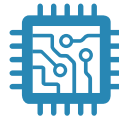
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