User Guide

OPAL Acquisition System

MOUNT SOPRIS
INSTRUMENTS

Advanced Logic Technology

V20.04.24

Advanced Logic Technology sa

ZAE Solupla,
Route de Niederpallen 30H
L-8506 Redange-sur-Attert
Luxembourg

Phone : +352 28 56 15-1
Fax : +352 28 56 15 40
Email : support@alt.lu
Web : www.alt.lu

Mount Sopris Instruments Co., Inc.

4975 E. 41st Ave.
Denver, CO 80216
USA

Phone : +1 303 279 3211
Fax : +1 303 279 2730
Email : tech.support@mountsopris.com
Web : www.mountsopris.com

Table of contents

1 INTRODUCTION

The **OPAL** acquisition system is based on a modern electronics design in which software control techniques have been used to the best advantage. The hardware incorporates the latest electronic components with embedded systems controlled via the specially developed **LOGGER SUITE** Windows interface program.

The system design philosophy is unique in two respects, firstly it has been built to accommodate multivendor tool types, and secondly it is totally software controlled.

The basic system design criteria are as follows:

- Windows operating system platform
- Rugged rack mount chassis construction, heavy duty, and fault tolerant electronics
- Easy to use, on-screen graphical user interface -The Dashboard featuring self-diagnostics, with the system configurable through screen dialog boxes, and minimal technical knowledge required of the user
- Modular design for ease of maintenance
- Multi tool family capability by the means of dedicated tool specific adapter modules
- High speed USB connection to computer
- Wireline and winch flexibility - runs on coax, mono or multi conductor wireline
- High speed up hole telemetry system and automatic telemetry tuning
- Shaft encoder flexibility - compatible with any 12V or 5V AB shaft encoder, and configurable for any combination of wheel-shaft PPR
- Wireline tension monitoring. Tension adapter compatible with any tension sensors-gauges.
- Up to 8 Analog inputs to collect information from external sensors
- “Scientific Data Systems Inc – Warrior” connectors-wiring compatibility

2 SYSTEM OVERVIEW

Figure 2-1 OPAL system

2.1 TECHNICAL SPECIFICATIONS

Dimension (W x L x H)	52 x 50 x 21 cm 20.5 x 19.7 x 8.3 in
Weight	21.5 Kg (46.3 lbs)
Input Voltage	100 – 240 VAC, 50 – 60 Hz inverter compatible
Tool Power	Up to 400V / 1.3 A - (750 W) Optional configuration: 2.6 A – (1500W)
PC Connection	High Speed USB
Logging Cable	Standard single, multi conductor and coax
Tools / Telemetry	ALT Standalone Tools, ALT/MSI QL Probe line, KUSTER & PROBE1 Tools, other third party tools on demand
Upgradeability	User upgradeable firmware
Software	Logger Suite V 12.1 or later

2.2 OPAL COMPONENTS

The **OPAL** acquisition system is built using a 19" – 3U rack which has been divided into a front section for digital-analog power supplies, tool adapters, Jazz-USB adapter, and a rear section for wireline, encoder, tension adapters and computer interface.
The front and rear adapters are connected to a central BUS via DIN41712 Eurocard connectors.

A **TDK Lambda** rack mount (19" – 1U) Programmable Power Supply is supplied in conjunction with the OPAL system. The TDK Lambda regulates the voltage and current output on to the tool power bus lines according to the instructions received by the OPAL and Logger Suite program for a specific logging tool. The TDK Lambda power supply is fully and automatically controlled by the OPAL system.

The whole system is rated to 400V-1.3A-750W in its standard configuration.

Note:
For tool operation requiring more than 300V supply all mounted "tool adapters" that were recovered from an ancient ALTLogger system must be modified to support a 400V supply (contact ALT for more details). Other temporary option is to remove the old "tool adapters" from the system for high power tool operation.

The OPAL and TDK Lambda Power Supply are mounted in a dedicated enclosure ensuring a good protection from external shocks.

2.2.1 OPAL - REAR VIEW

Figure 2-2 OPAL rear panel

REAR PANEL components - from right to left:

2.2.1.1 MAIN AC adapter

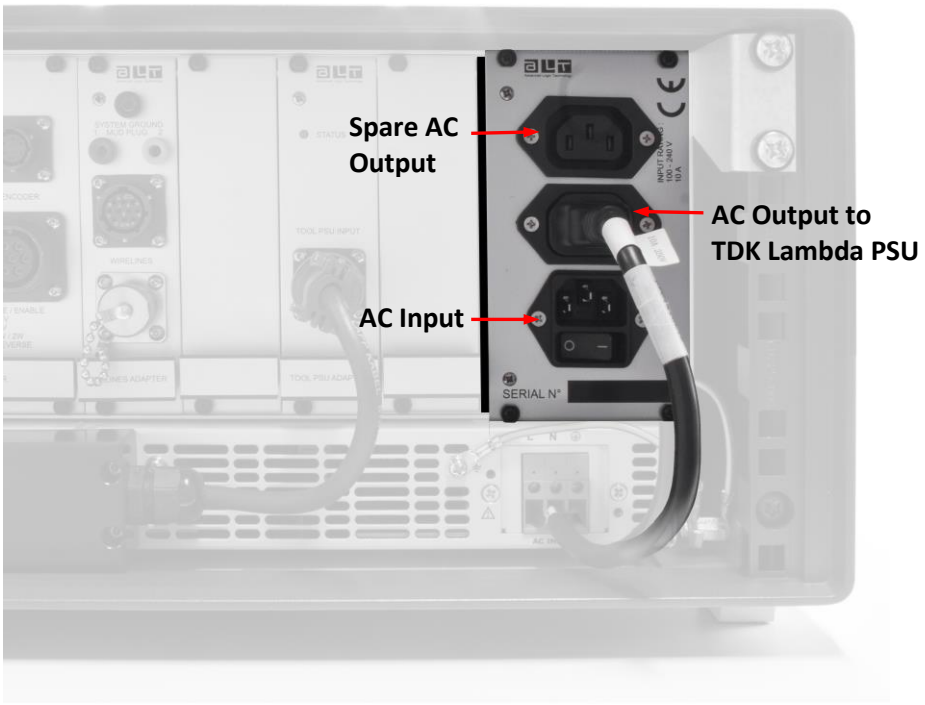


Figure 2-3 Main AC adapter

The main AC adapter includes a main AC input (100 – 240 VAC, 50-60 Hz) and two AC outputs to route AC power to the TDK lambda PSU and to any other external device (i.e. laptop, …).

Main AC power input is controlled by a power switch and as well as featuring the two AC outputs is also used to feed the two DC power supplies located on the left side of the OPAL front panel (refer to § 2.3).

Protection fuses are located on the Main AC board.
There are four **10A-240VAC line fuses** (labelled F3-F4-F5-F6) and two **3.15A-240VAC Slow fuses** (labelled F1-F2) installed to protect the system from power surge or short circuit (Figure 2-4).

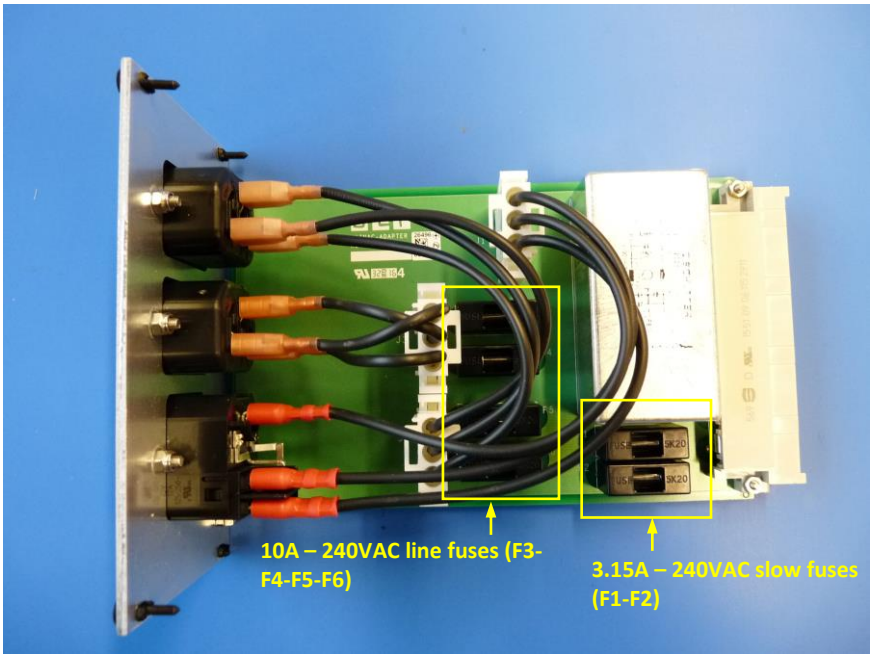


Figure 2-4 AC adapter – main fuses

2.2.1.2 TOOL PSU adapter

Figure 2-5 Tool PSU adapter

The "Tool PSU adapter" provides a simple link between the TDK Lambda Programmable Power Supply via a MIL 4 way connector[1] to the pins dedicated to tool power supply on the rack bus connector.

The **Green LED** located at the top of the adapter must always be illuminated. It monitors the tensions delivered by the two power supplies **PSU-D** & **PSU-A** located on the front panel.

If the **LED** is **OFF**, a fault can be suspected with the PSU-D and/or PSU-A power supplies.

2.2.1.3 WIRELINE adapter

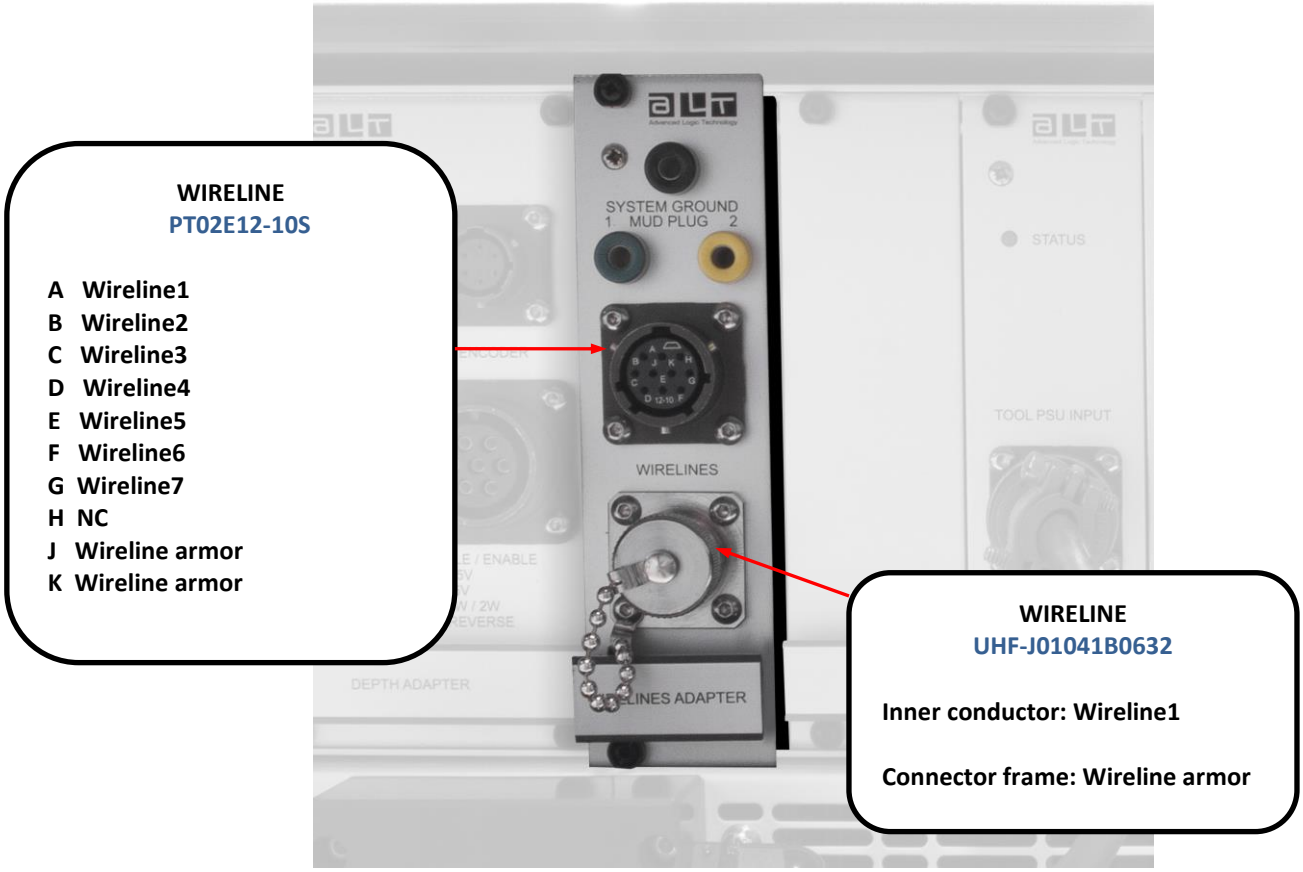


Figure 2-6 Wireline adapter

The "Wireline adapter" provides direct links between the logging wireline and the adapter MIL 10 way connector PT07A12-10S, (mates with PT06E12-10P(SR)), or UHF-J01041B0632 coaxial connector (requires J01040B0604 counter plug) dedicated to the

[1] Connectors are to MIL-C-26482 or MIL-C-5015 standards, Amphenol, ITT-Canon or equivalent

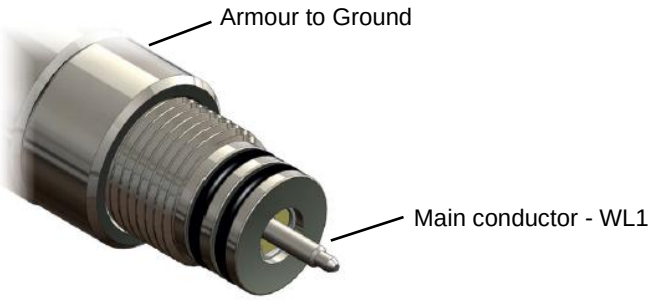
wireline on the rack bus. The connector pin-out is detailed above (Figure 2-6).

WARNING: ***the MIL 10 way and UHF connectors are wired in parallel. Tool power is supplied on the two connectors. Make sure to set the cap on the unused connector to avoid any electrical arc at the back of the system.***

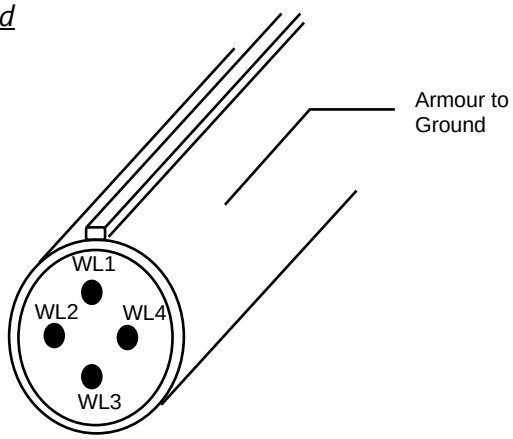
The OPAL acquisition system supports a wide range of wireline types; coax, mono, multi-conductor are possible.

The following are examples of the Gearhart Owen standard cable head connectors:

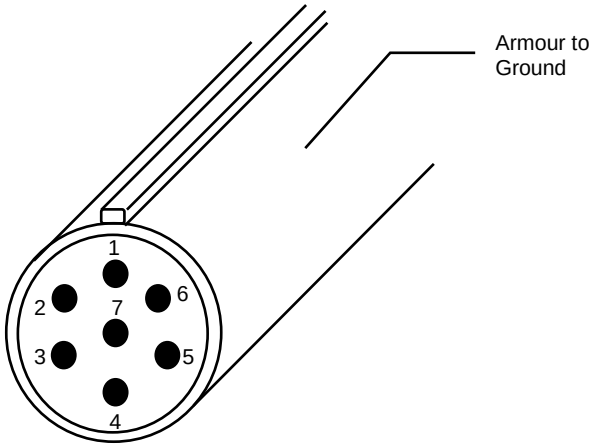
Mono Conductor Cable Head



Gearhart 4 Conductor Cable Head



Gearhart 7 Conductor Cable Head



The **ALT** reference **wiring modes** are listed in the table below as a guideline:

T0 – Mono conductor	
WL1	COM+
T1 – 4 conductor	
WL1	COM+
WL2	AUX1 (mud plug)
WL3	COM-
WL4	AUX2
T2 – 4 conductor	
WL1	COM+
WL2	COM+
WL3	COM-
WL4	COM-
T3 – 7 conductor	
WL1	COM+
WL2	COM+
WL3	AUX1 (mud plug)
WL4	COM-
WL5	COM-
WL6	AUX2
WL7	nc
T5 – 7 conductor	
WL1	COM+
WL2	COM-
WL3	AUX1 (mud plug)
WL4	COM+
WL5	COM-
WL6	AUX2
WL7	nc

WARNING: ***Check your cable head and wireline with a continuity meter before wiring the cable plug connected to OPAL.***

Note:
The signals transmitted through the wireline conductors are controlled by the ALT MODEM located on the front panel of the OPAL system. The ALT MODEM configures and assigns the power, comms and auxiliary lines based on the probe top wiring and cable head wiring defined by the user in Logger Suite application.

Three 4mm Banana Panel Mount Sockets are located at the top of the adapter:

- The **BLACK** banana socket is used to connect an **earth stake** to the **system ground**.

- The **YELLOW** banana socket labelled **"Mud Plug 1"** is connected to **Aux 1** (auxiliary line 1). "MudPlug1-Aux1" is generally used for resistivity logging, when no isolation bridle is attached to the resistivity probe, to connect a **reference potential electrode** to the system.[2]

- The **GREEN** banana socket labelled **"Mud Plug 2"** is connected to **Aux 2** (auxiliary line 2). Currently it is unused.

The Mud plugs are only active when the ALT MODEM is configuring and assigning auxiliary lines for the telemetry mode defined by the probe top wiring. Refer to the "Wiring modes" table on page 9.

[2] The 3 banana sockets described above were not hard-wired on the first batch of OPAL systems manufactured. Connections to System Ground and to Mud Plug were only active on the ALT MODEM front panel (§ 2.2.2.4). If necessary contact ALT to obtain complementary information about your system configuration.

2.2.1.4 DEPTH adapter

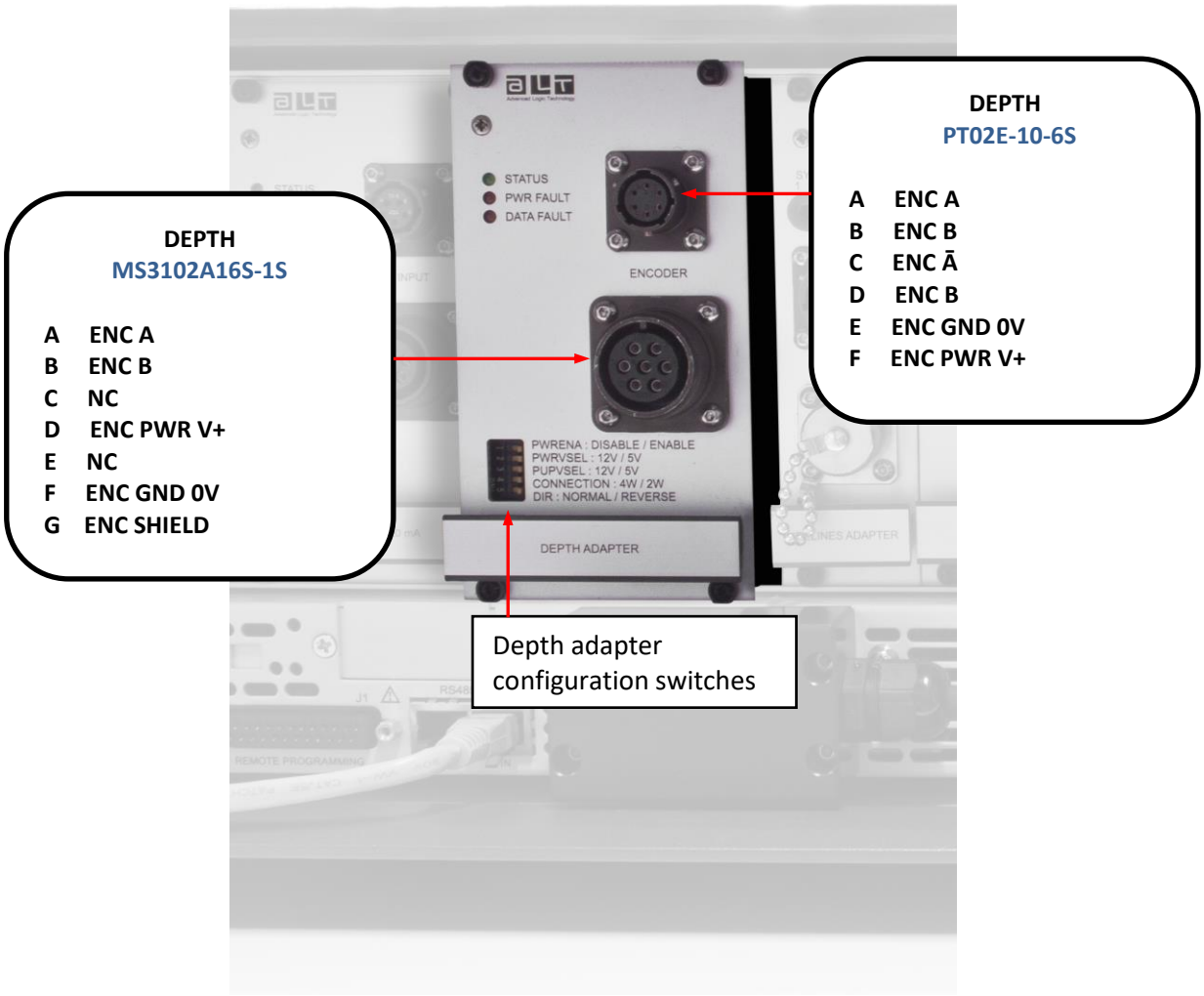


Figure 2-6 Depth adapter

The "Depth adapter" is a universal encoder interface which provides the facility for operating most quadrature encoders.
The adapter has four input channels available and requires a minimum of two square wave inputs, A and B, differing by 90° of phase to determine the direction.
With a four channel output encoder the inverted A-, B- are also present and give increased reliability of the depth counting.

Both **5V** and **12V** units are supported.

An encoder is connected to the "Depth adapter" via the MIL 6 way PT02E-10-6S chassis socket, (mates with PT06E-10-6P(SR) cable plug), or 7 way MS3102A16S-1S type connector (requires MS3106A-16S-1P cable plug). The pin-out is detailed on Figure 2-6.

The depth adapter must be configured to suit your depth encoder specifications. The following table is listing the **switch configurations** available (Figure 2-6):

Mnemonic	Description	LEFT position	RIGHT position
PWRENAB	Power Enable	Disable	Enable
PWRVSEL	Power Voltage selection	12V	5V
PUPVSEL	Pull-up voltage selection	12V	5V
CONNECTION	Depth encoder wiring	4 Wires	2 Wires
DIR	Direction	Normal	Reverse

Three LEDs are located on the upper left corner of the depth adapter giving information on its working status:

- The **GREEN** LED means that the depth encoder and depth adapter are properly configured and functional.

- The **RED-PWR Fault** LED indicates an encoder power fault. Such a fault can occur when:

  - The **PWRENAB** switch (Power Enable) is enabled and current drawn by the encoder is inferior to 20 mA (i.e. no depth encoder connected to the system) or superior to 520 mA (i.e. encoder fault/short circuit).

- The **RED-Data Fault** LED monitors the encoder signal integrity. The LED is illuminated when:

  - The configuration of the depth adapter switches is not compatible with the depth encoder specifications.
    Check more specifically the "2 wires - 4 wires" switch option (i.e. the CONNECTION switch is set to "4 wires-left position" and the depth encoder is designed to provide two square wave inputs (A, B). The system is expecting to receive 4 square wave inputs (A, A-, B, B-) and only receives two.

  - The CONNECTION switch is set to 4 wires and there is no encoder status correlation between the A, A- and/or B, B- square wave signals (i.e; input channels A, A-, B, B- are incorrectly wired).

  - The depth encoder is faulty

> **Note:** when applying a correction to the depth adapter configuration it is necessary to rotate the depth encoder shaft to refresh the LEDs status.

2.2.1.5 TENSION adapter

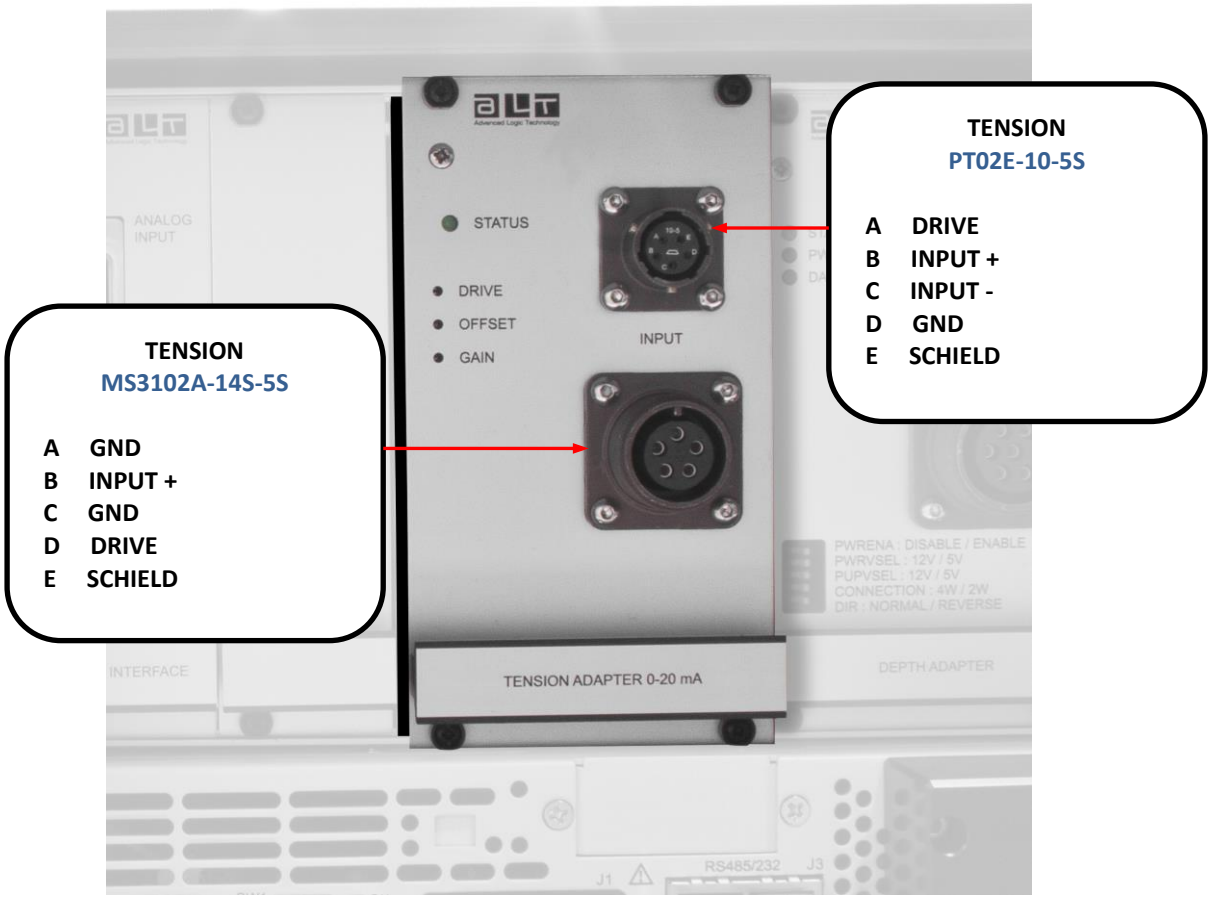


Figure 2-7 Tension adapter 0-20 mA configuration

The tension adapter can support three types of tension sensors to monitor the wireline tension:

1. Tension sensor with **0-20 mA** signal output
2. Tension sensor with **0-10V** signal output
3. Strain gauge

The OPAL acquisition system comes standard with the tension adapter configured for 0-20 mA signal input. The other tension adapter configurations are available on demand.

The tension device is connected to the "tension adapter" via a MIL 5 way PT02E-10-5S connector, (mates with PT06E10-5P(SR) cable

plug) or via a 5 way MS3102A-14S-5S type connector (requires MS3106A-14S-5P cable plug). Refer to Figure 2-7 for the connector pin out.

A **GREEN** LED at the upper left corner of the board indicates the working status of the tension sensor and tension adapter.

The tension adapter may require some fine tuning of the tension **DRIVE**, **OFFSET** and **GAIN** to obtain consistent tension readings. Three small holes on the adapter give access to potentiometers for this purpose. A small flat screw driver will be needed to perform the adjustments if required.

With the standard configuration:

- **DRIVE** is set to **10V**
- **OFFSET** is the zero baseline and is always set **positive** (higher than zero)
- **GAIN** is fixed to **22 mA - full scale** to avoid signal saturation

2.2.1.6 JAZZ Interface

Figure 2-8 JAZZ Interface

The Jazz Interface has three main functions:

1. It furnishes the direct link between the TDK Lambda external power supply and the Jazz board located at the front of the OPAL acquisition system. A dedicated RS485 cable connects the **TDK Lambda port "J3 IN"** to the Jazz interface "**External RS485 OUT TOOL PSU"** port.

2. It is the entry port for the **USB** cable linking the user's computer to the acquisition system.

3. The DB26 connector is the entry point for **8 Analog Inputs** (-1V/+1V – 24 bits). A 12V supply can be delivered to external sensors from this port. Below is the pin-out of the DB26 connector.

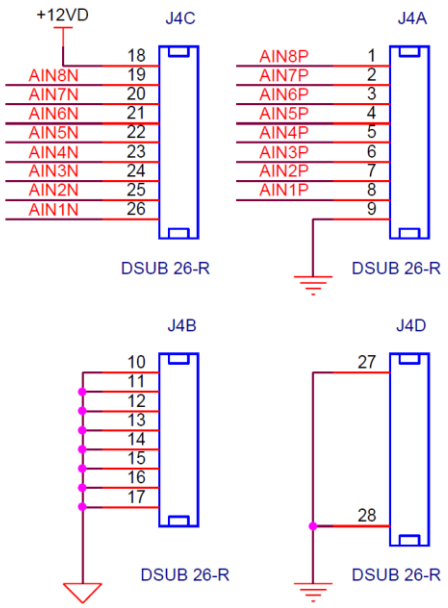


Figure 2-9 DB26 Pin out

REMARK:

Three free slots are located at the back of the system (Figure 2-2 – page 4). The boards labelled **"adapters"** may be exchanged and inserted in a different slot.
The board labelled **"Jazz Interface"** must always be positioned opposite the JAZZ board located at the front.

2.2.2 OPAL - FRONT VIEW

Figure 2-10 OPAL front panel

FRONT PANEL components - from left to right:

2.2.2.1 DIGITAL POWER SUPPLY (PSU-D)

The "digital power supply" occupies a dedicated slot at the extreme left hand of the front panel. It delivers +12V output to digital circuitry. The green LED status should always be illuminated when system main power switch is ON.

2.2.2.2 ANALOG POWER SUPPLY (PSU-A)

The "analog power supply" occupies a dedicated slot just next to the "digital power supply" described above. The two power supplies must not be swapped or inserted in any other free slots.

The "analog power supply" delivers +15V and -15V outputs to analog circuitry. The green LED status should always be illuminated when system main power switch is ON.

Figure 2-11 Digital (PSU-D) and Analog (PSU-A) power supplies

2.2.2.3 FREE SLOTS

The OPAL acquisition system has eight free slots on the front panel to integrate third party telemetry modems if required.
The position of the telemetry modems in the free slots has no importance.

2.2.2.4 ALT MODEM

As standard the **ALT MODEM** is designed to operate tools using the **ALT** (standalone and Quick Link tool families), **PROBE1** https://www.probe1.com/) and **KUSTER** (https://kusterco.com/ telemetry communication protocols.

Figure 2-12 ALT Modem

All signals transmitted through the wireline conductor(s) are controlled by the ALT MODEM.

The ALT MODEM main functions are listed hereafter:

- It drives and assigns automatically the power, communication and auxiliary lines based on the probe top and cable head wiring defined by the user in Logger Suite application.

- It tunes automatically the telemetry on any wirelines and applies an **Equalizer** and **Train** processes to optimize the telemetry performance on long wirelines[3].

- It offers multiple display options (Analysis info and Scope views) for checking and fine-tuning the telemetry settings.

- It is compatible with ALT, Probe1 and Kuster tool telemetry communication protocols and offers options to interface other third party tools.

[3] These processes are only applicable in conjunction with ALT tools implementing the QLMODEM-PSU telemetry board.

Two **GREEN** LEDs are located at the top of the ALT MODEM and are flashing when the ALT MODEM is active.

"Mud plug" and **"System Ground"** 4mm sockets can be used to connect respectively a reference potential electrode and an earth stake for resistivity logging.

The Mud plugs are only active when the ALT MODEM is configuring and assigning auxiliary lines for the telemetry mode defined by the probe top wiring. Refer to the "Wiring modes" table on page 9.

The **DB9 connector** mounted on the front plate is dedicated to ALT engineers for program upgrades.

2.2.2.5 JAZZ

The JAZZ board is the main interface between the user's computer and OPAL components. Its functions comprise:

- Collecting, controlling and digitizing information coming from other adapters (depth encoder, tension, analog inputs)
- driving the TDK Lambda external power supply
- driving external USB devices and USB communication to computer
- managing the data flow

Figure 2-13 JAZZ – USB interface

The JAZZ board includes a duplicate entry port for the **USB** cable to link the user's computer and acquisition system.
Two additional USB ports are available at the top of the board to connect external USB devices (memory stick, mouse, etc…).

Eight LEDs are mounted on the JAZZ front panel. They can be used to monitor the functionality of the OPAL components and data transfer. The table below gives a description of each LED status.

Mnemonic	Description	LED Color	Working status
M-BUS	Modem Bus status	**Green**	**Flashing**. It monitors telemetry activity and displays (i.e. Analysis Info, Scope views,…) on the fast Modem Bus.
N-BUS	Internal Network Bus status	**Green**	**Flashing**. It monitors the control commands (i.e. discriminator levels) sent to the slow Network Bus.
TOOL COM	Tool communication status	**Green**	**Flashing** when tool communication is established with OPAL. It monitors data transmission.
TOOL ON	Tool Power status	**Green**	Must be **ON** when tool power is ON.
SYST FAULT	System status	**Red**	Must be **OFF** - If ON one or several adapter(s) report(s) a fault status. SYST FAULT repeats the Status Panel on the LOGGER dashboard.
PCLINK	USB Link Status between computer and acquisition system	**Green**	Must be **ON** when computer is connected to OPAL and flashing when Logger Suite software is launched.
TOOL PSU	Programmable Power Supply status (TDK Lambda)	**Green**	Must be **ON** when the TDK Lambda Power Supply is powered ON and Logger Suite software is launched.
JAZZ FAULT	Jazz functionality status	**Red**	Must be **OFF.** If ON there is a major fault with the system.

3 TROUBLESHOOTING

Observations	To Do
OPAL Power Switch is ON. No power is supplied to the system.	1. Check Main AC source (power generator, inverter, power outlet). 2. Verify that the power cord is properly plugged into the AC Input socket. 3. Check fuses on Main AC adapter – refer to §2.2.1.1 - page 5 for more details.
Main AC power is fed to OPAL. LED is red in the "Tool" panel of Logger dashboard.	1. Verify the switch position on the "TDK Lambda Programmable Power Supply" front panel. It must be is turned ON. 2. Check the LED status on the Tool PSU adapter and verify the 4 way MIL connection. 3. Check that the RS485 cable between the TDK Lambda port "J3 IN" and the Jazz Interface "External RS485 OUT TOOL PSU" port is connected.
No depth is read by the system.	1. Check the switch configuration on the depth adapter. Make sure the switch configuration is matches the depth encoder specifications. 2. Check the wiring of the depth encoder to OPAL. 3. Verify the functionality of the depth encoder using an external power supply and scope.
No tension is read by the system.	1. Verify that the tension adapter hardware configuration can handle the tension sensor signal output. 2. Check the wiring of the tension sensor to OPAL. 3. Check the functionality of the tension sensor.
LOGGER software always starts in demo mode.	1. Check the JAZZ board functionality status. The "JAZZ FAULT" status should be OFF on the JAZZ board. 2. Check the USB cable 3. Check the USB link between PC and OPAL. Try another USB port. 4. Check that OPAL USB drivers are properly installed. USB drivers should be visible in the computer's Control Panel/System & Security/System/Devices manager. Re-install the USB drivers if necessary.

All LEDs are OFF on JAZZ board	1. Check the LED status on the Digital and Analog PSU. Possible cause – defective power supply.
Analysis info and scope are not displayed in the "Telemetry and Equalizer" dialogs.	1. Verify the M-BUS status on the JAZZ board. It must flash when telemetry is established with the tool. 2. Close LOGGER software. Turn OFF/ON OPAL main power switch. Re-start LOGGER software