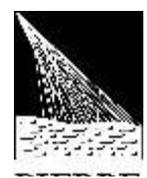


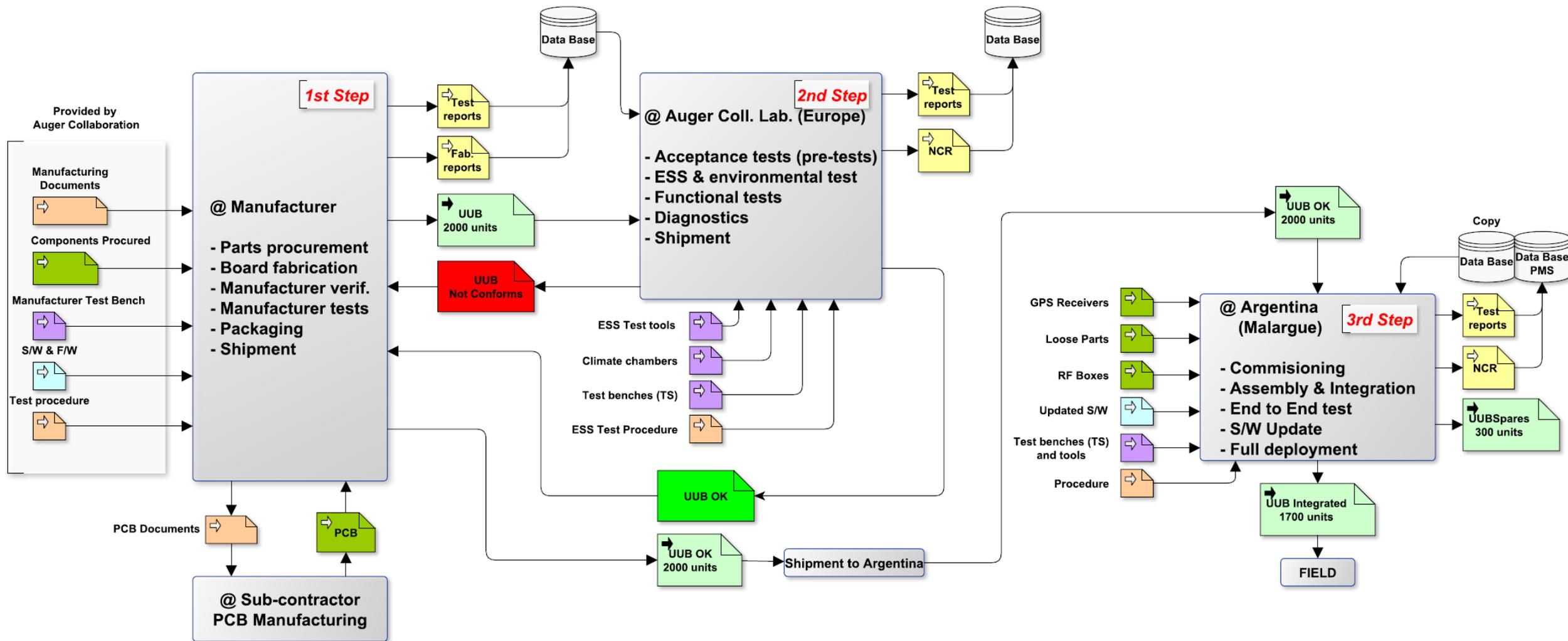
Surface Detector Electronics Upgrade

UUB V3 Failures, Spares & Maintenance Status

Malargue, April 14th 2024



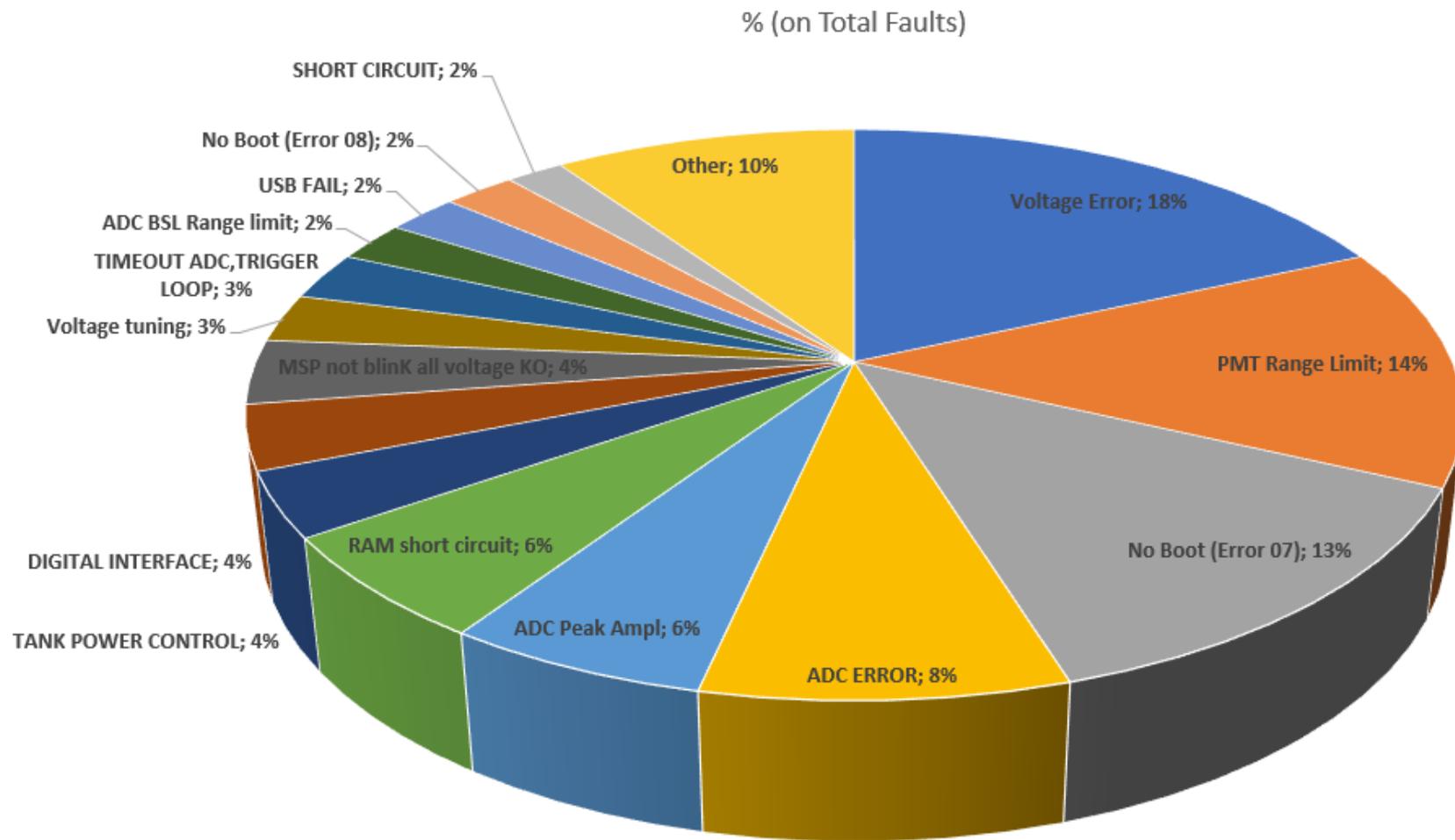
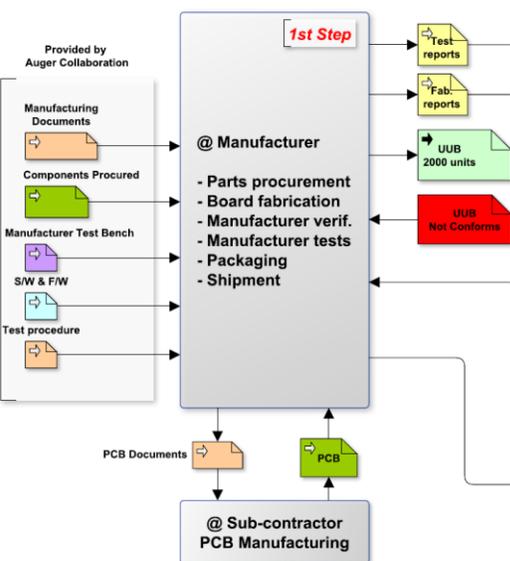
UUB – tests process





UUB – Manufacturer Tests

**Failure rate of the 1st tests: 24%
(74% passed without retesting)**



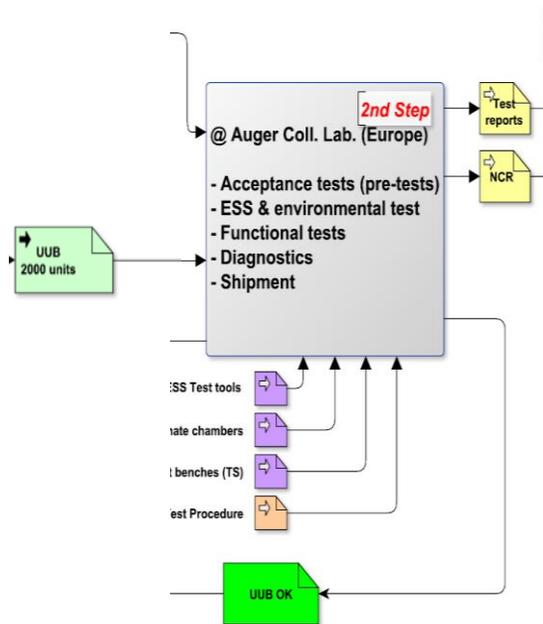
Mitigations:

- Component exchange
- Reworking
- Process adjusted
- Test bench adjusted

■ Voltage Error	■ PMT Range Limit	■ No Boot (Error 07)	■ ADC ERROR
■ ADC Peak Ampl	■ RAM short circuit	■ TANK POWER CONTROL	■ DIGITAL INTERFACE
■ MSP not blink all voltage KO	■ Voltage tuning	■ TIMEOUT ADC, TRIGGER LOOP	■ ADC BSL Range limit
■ USB FAIL	■ No Boot (Error 08)	■ SHORT CIRCUIT	■ Other

UUB – ESS tests

Failure rate : 10%



Including:

- **ADCs**
 - initialization problems
 - Flipping bits, (2%)

- **Some baseline instabilities at high temperatures**

- **Some 3.3 V DC/DC converter failures**

Mitigations:

- **Component exchange (by A2F or @ Malargue, ADC, DC/DC conv.)**
- **Reworking (by A2F or @ Malargue)**
- **Software patch**
- **Acquisition process adjusted**

UUB – On site Tests

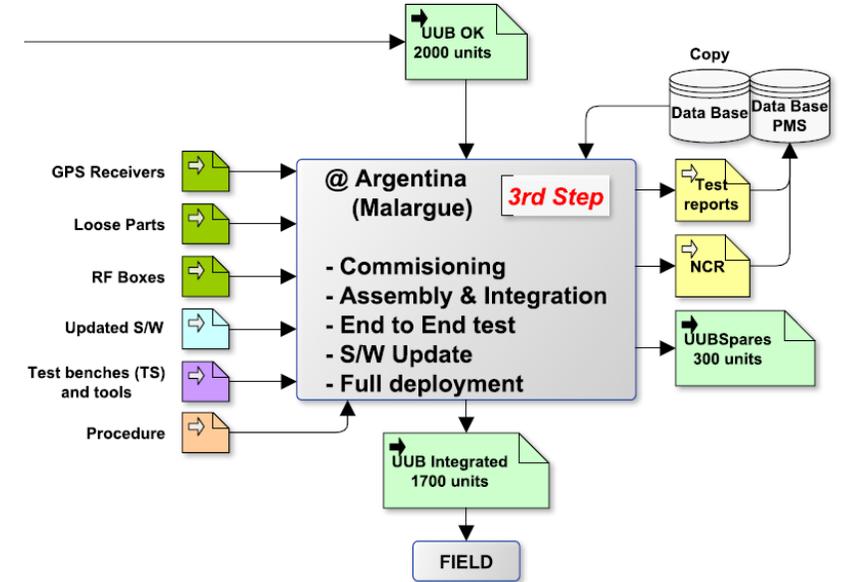
11 UUB with bad ADC, flipping bits (sent in Malargue before knowing of the problem, can be repaired by replacing the ADCs)

302 UUB rejected from tests at Malargue (18%) but only 10 with failures (0.5%):

- 9 with 1 TRACO DC/DC failure (replaced)
- 1 with ADC initialization problem
- 292 with fabrication or packaging Quality default (17%) (repaired)

79 UUB returned from the field but 65 UUB with failure (3,5%):

- 56 with problems which can be repaired
- 9 with e-Fuse problem, cannot be repaired without changing the FPGA (discarded)



UUB Procedures

Procedures for UUB maintenances are stored at the Pierre Auger Observatory → <https://www.auger.org.ar/SDEU/>



Pierre Auger Observatory
SDEU Malargüe Task Home Page

Andres Travaini

Web Site under construction/Sitio web en construcción



General Information/Información General

- ▶ Pierre Auger Info
 - ▶ Auger Site (English)/Sitio Auger en Inglés
 - ▶ Auger Site (Spanish)/Sitio Auger en Español
 - ▶ Papers and reports
- ▶ SDEU Info
 - ▶ What is SDEU?/¿Qué es SDEU?
 - ▶ UUB/SPMT/SSDPMT
- ▶ Shipments
 - ▶ Shipment table/Tabla de envíos
- ▶ SDEU deployment/Instalación de SDEU
 - ▶ SDEU deployed/SDEU instalados
 - ▶ Interactive Map/Mapa Interactivo
 - ▶ Map/Mapa opcional (en construcción)
 - ▶ Static Map/Mapa estático (30Mb)
 - ▶ Atlas (map in several sheets)/Atlas (mapa en varias hojas)
 - ▶ E-log shortcut/Atajo al E-log
 - ▶ Reportes diarios breves (En Castellano)
- ▶ SDEU Assembly and Test/Ensamblado y Testeo de SDEU
 - ▶ UUB inspection status/Estado de UUB inspeccionadas
 - ▶ Praga Tests Database/Base de datos de testeo de Praga
 - ▶ Praga Tests Grafana/Grafana Testeo de Praga
- ▶ SDEU Safety / Seguridad en SDEU
 - ▶ Risk Matrix/Matriz de evaluación de riesgos
 - ▶ Lista de Riesgos en SDEU

Procedures (under construction)/procedimientos (en construcción)

- ▶ Procedures index/Índice de procedimientos (Prod/Deploy)
- ▶ Maintenance Procedures/Procedimientos de Mantenimiento

Production Documents (en construcción)

- ▶ Production Documents

ESD Safe Area (under construction)/Area Segura de ESD (en construcción)

- ▶ Documents on ESD/Documentos sobre ESD

Inventory

- ▶ AB (ESD Safe Area and Assembly Room) + Massive Storage at AB
- ▶ Field teams 

Personnel

- ▶ Local Staff

UUB Procedures

General procedures for deployment

Procedures and Instructions (General for PAO)/Procedimientos e Instrucciones generales del PAO

- ▶ Pick-Up usage/Usos de Camionetas
- ▶ Emergencies/Emergencias
- ▶ Work under adverse weather/Trabajo en clima adverso
- ▶ Personal Protection Equipments/Elementos de Protección Personal
- ▶ Radio Communications/Comunicaciones por Radio
- ▶ Battery chemicals/Químicos de baterías
- ▶ Private property access/Accesos a campos privados
- ▶ Absences because of illness/Ausencias por enfermedad
- ▶ Travel expenses/Viáticos
- ▶ Departures during working hours/Salidas en horarios de trabajo

SDEU specific procedures for deployment & Integration

Procedures and Instructions (specific for SDEU)/Procedimientos e Instrucciones específicos de SDEU

- ▶ Production Workflow/Flujo de trabajo de Producción
- ▶ Test & Deployment Workflow/Flujo de trabajo de testeo y Deployment
- ▶ EKIT Assembly/Ensamblado EKIT
- ▶ EKIT Testing/Testeo EKIT
- ▶ EKIT Testing (AMIGA connection)/Testeo EKIT (conexión AMIGA). Requires/Requiere login
- ▶ EKIT Troubleshooting (missing)/Solución de Fallas (faltante)
- ▶ EKIT Testing limits/Testeo EKIT, límites
- ▶ EKIT Instructivo de recuperación de UUB con UBOOT (Castellano)
- ▶ SPMT Assembly (missing)/Ensamblado SPMT (faltante)
- ▶ SPMT Testing/Testeo SPMT
- ▶ SPMT Deployment/Despliegue en campo de SPMT
- ▶ SSD PMT Assembly (missing)/Ensamblado SSD PMT (faltante)
- ▶ SSD PMT Deployment/Despliegue en campo del SSD PMT
- ▶ Deployment at field/Despliegue en campo
- ▶ Required skills/Habilidades requeridas.
- ▶ GPS reprogramming/Reprogramación GPS (Spanish)
- ▶ Comandos básicos para UUB en campo (Spanish)
- ▶ Modificación de TPCB (Spanish)

UUB Procedures

SDEU specific procedures for maintenance

Procedures (under construction)/procedimientos (en construcción)

- ▶ Procedures index/Índice de procedimientos (Prod/Deploy)
- ▶ Maintenance Procedures/Procedimientos de Mantenimiento

Production Documents (en construcción)

- ▶ Production Documents

ESD Safe Area (under construction)/Area Segura de ESD (en construcción)

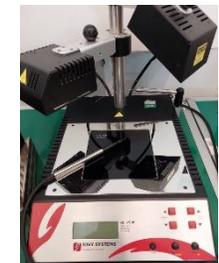
- ▶ Documents on ESD/Documentos sobre ESD

To Be Completed

Tools for Maintenance

Tools available in Malargue for SDEU Maintenance:

- Digital Phosphor Oscilloscope Tektronix TDS 3034 300MHz 2.5Gsa/s
- Mixed Signal Oscilloscope MSO3054 500MHz 2.5Gsa/s 16CH
- Power supply HP E3631A
- Power Supply MX180TP
- Power supply Kettor KD 3305D
- Waveform generator HP 3312A 15MHz
- True RMS multimeter Fluke 179
- Laptop ACER Aspire E15 – I5-5200U 6GB DDR3 1TB HDD
- Laptop Lenovo ThinkPad L580 I7
- Digital microscope Keyence VHX-970F
- Optical microscope Bausch & Lomb, Stereo zoom 4
- Infrared solder station Jovy RE 7500
- Hot air solder station Hakko 850B
- Weller Solder station WD 1M, only for UUB
- Weller Solder station WD 2M, UUB and TPCB
- Weller Zero smog EL air extractor with filtering
- 3 UUB Test benches (Siegen, KIT and Malargüe models)
- Lecce Box (PMT signal emulator)



Tools for Maintenance

Tools to be procured for SDEU Maintenance:

- Climate chamber Binder MKF56 with accessories
- Weller rework station 3 CH 400W WR3000MER
- Arbitrary Waveform Generator RIGOL DG 922 pro



UUB Production Status

(2001 units)

- **UUBs in Malargue:**
 - **31 units received in October 20 (Pre-production)**
 - **49 units received in February 21 (Pre-production)**
 - **84 units received in August 21**
 - **252 units received in December 21**
 - **420 units received in April 22**
 - **247 units received in June 22**
 - **420 units arrived in December 22**
 - **252 units arrived in March 23**
 - **100 units arrived in November 23**
- ***1855 units on site***
- **146 remaining UUB to be shipped asap**



**YOU ARE
HERE**

UUB Spare Units



UUB Production Status
(2001 units)

- UUBs in Malargue:
 - 31 units received in October 20 (Pre-production)
 - 49 units received in February 21 (Pre-production)
 - 84 units received in August 21
 - 252 units received in December 21
 - 420 units received in April 22
 - 247 units received in June 22
 - 420 units arrived in December 22
 - 252 units arrived in March 23
 - 100 units arrived in November 23

→ 1855 units on site

146 remaining UUB to be shipped asap

YOU ARE HERE

At SITAEI (A4F) place:

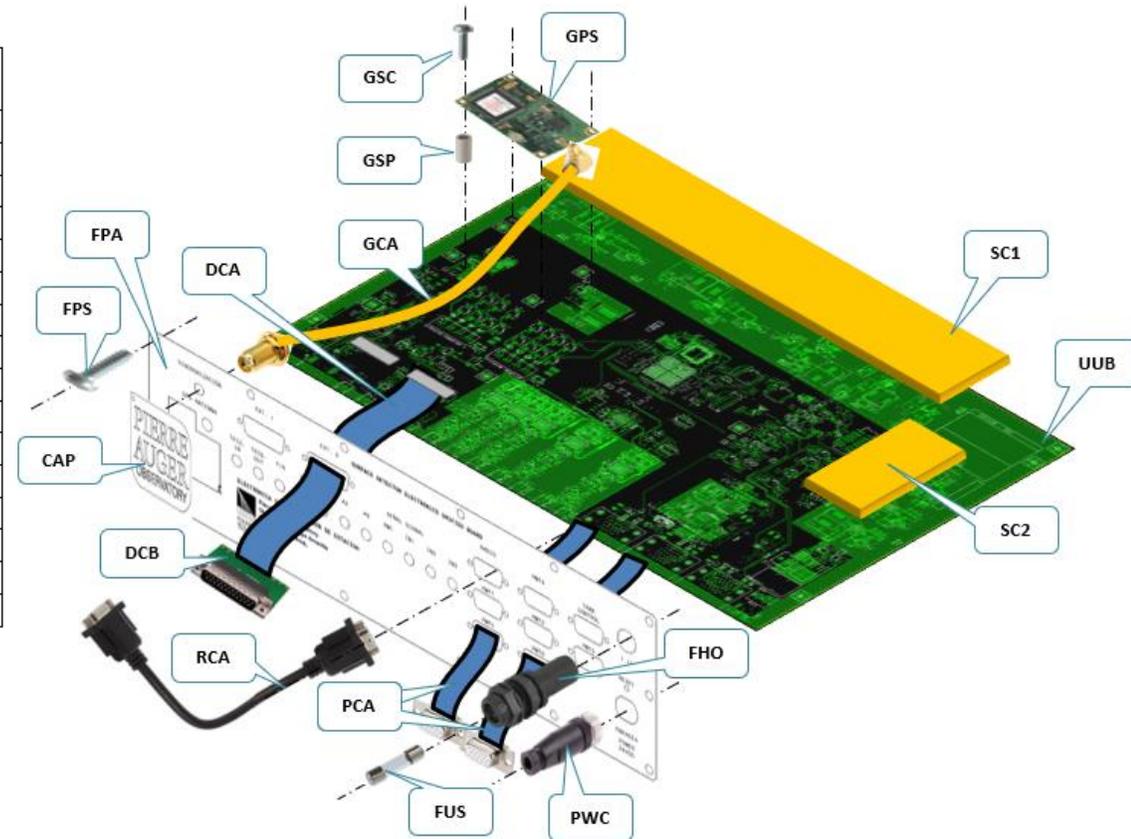
- 17** to be reworked
- 23** to be retested (reworked)
- 9** reworked, tested OK to be sent to Prague
- 7** back from Prague, OK
- 33** to be investigated/repared
- 2** UUB golden units
- 10** to be discarded
- 1** at Palermo, OK
- 44** in Prague, OK

54 + 202 = 256 good spare UUB available today



UUB Loose Parts

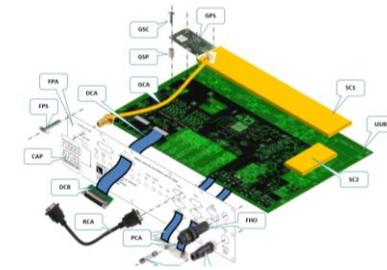
Code	Name	Version ³	Comments	Qty ⁴
GPS	GPS receiver ¹	01	GPS receiver board SSR-6TF	1
GSC	GPS screw	01	For GPS receiver board mounting, top and bottom	8
GSP	GPS spacer	01	Plastic spacers for GPS receiver board mounting	4
FHO	Fuse holder & cable	01	Mounted on the front panel	1
FUS	Fuse	01	Placed in the fuse holder, value = 1.5 A	1
GCA	GPS cable	02	SMA (front panel) to MMCX antenna coaxial cable	1
DCA	Digital cable	03	24 points ribbon cable with connector on UUB side	1 ⁵
DCB	Adaptor Board & Connector	01	SubD 25 point connector with pitch adaptation PCB	1 ⁵
PCA	PMT cable	03	DB15HD (front panel) to HE14 (UUB) flat cable	2
RCA	Radio cable	02	DB9 to DB9 molded cable (external)	1
SC1	Shielding cover 1	01	DC/DC shielding, size 1	1
SC2	Shielding cover 2	01	DC/DC shielding, size 2	1
PWC	Power supply connector	01	Binder plug connector (external)	1
CAP	USB Plastic dust cover	02	Plastic dust protection on USB connectors	1
FPA	Front panel	03	UUB front panel	1
FPS	Front panel screw ²	01	To fix the front panel on the enclosure	14



¹ – GPS receivers are tested and provided through the CWRU Group and KIT.
² – Front panel screws already procured and stored in Malargue
³ – The version number displayed here is valid for the UUB version 3
⁴ – The quantity needed for one UUB, x 2000 for full quantity
⁵ – The quantity is for Radio Detector only. Spares will be used for AMIGA connection

UUB

Loose Parts Status



Code	Name	Comments	Qty per UUB	Qty needed 2000 UUB	Qty Procured	Status
GPS	GPS receiver	GPS receiver board SSR-6TF	1	2000	2000	OK
GSC	GPS screw	For GPS receiver board mounting, top and bottom	8	16000	16000	OK
GSP	GPS spacer	Nylon spacers for GPS receiver board mounting	4	8000	2100	To Be Verified
FHO	Fuse holder & cable	Mounted on the front panel	1	2000	2000	OK
FUS	Fuse	Placed in the fuse holder, value = 750 mA	1	2200	2200	OK
GCA	GPS cable	SMA (front panel) to MMCX antenna coaxial cable	1	2000	2100	OK
DCA	Digital cable	24 pins ribbon cable with TCMD connectors (SAMTEC)	1	2000	2000	OK
DCB	Adaptor Board	Small PCB with DB25 FP connector	1	2000	2000	OK
PCA	PMT cable	DB15HD (front panel) to HE14 (UUB) flat cable	1	2000	2000	OK
RCA	Radio cable	DB9 to DB9 molted cable (external)	1	2000	2700	OK
SC1	Shielding cover 1	DC/DC shielding, size 1	1	2000	2000	OK
SC2	Shielding cover 1	DC/DC shielding, size 2	1	2000	2000	OK
PWC	PSU connector	Binder plug connector (external)	1	2000	2100	OK
FPA	Front panel	UUB front panel (with label)	1	1800	1600	To Be Verified
CAP	Cover Cap	Front panel USB cap cover	1	2000	1700	OK
FPS	Front panel screw	To fix the front panel on the enclosure	14	28000		Re-used - OK

50 Ohms termination → 2200 units, OK

Binder socket nuts → OK

UUB Spare components

Reference	Description	Qty needed to procure	Qty @ Malargue	Ordered (DigiKey)	STATUS
AD9628BCPZ-125	IC ADC 12BIT PIPELINED 64LFCSP	20	109		
REF3212AIDBVT	IC VREF SERIES 0.2% SOT23-6	20		20	
LM224D	IC OPAMP GP 4 CIRCUIT 14SOIC	20	66		Difficult to procure
ADG608BRUZ	IC MUX 8:1 30OHM 16TSSOP	40	3	40	
ECMF04-4HSM10	CMC 100MA 4LN SMD ESD	100	20	100	
SN65LVDS180PW	IC TRANSCEIVER FULL 1/1 14TSSOP	100	6	100	
MSP430F2618TPM	IC MCU 16BIT 116KB FLASH 64LQFP	20	2	40	
FT232RL-REEL	IC USB FS SERIAL UART 28-SSOP	20	21		Difficult to procure
88E1512-A0-NNP2I000	IC TXRX FULL/HALF 4/4 56QFN	20	3	25	
MF-MSMF010-2	PTC RESET FUSE 60V 100MA 1812	100	6	100	
MF-MSMF014-2	PTC RESET FUSE 60V 140MA 1812	50		50	
MF-MSMF020-2	PTC RESET FUSE 30V 200MA 1812	50		50	
MAX8556ETE+	IC REG LINEAR POS ADJ 4A 16TQFN	50		50	
ADM6320CZ27ARJZ-R7	IC SUPERVISOR 1 CHANNEL SOT23-5	20	17		20 procured by INFN
ADA4927-2YCPZ-R2	IC OPAMP CFA 2 CIRCUIT 24LFCSP	20			50 procured by INFN
MAX4080SASA+	IC CURRENT SENSE 1 CIRCUIT 8SOIC	20	19	20	
LM3150MH/NOPB	IC REG CTRLR BUCK 14TSSOP	20	3	40	
LMR23630ADDAR	IC REG BUCK ADJUSTABLE 3A 8SOPWR	20		50	
MT25QL01GBBB8ESF-0SIT	IC FLASH 1GBIT SPI 133MHZ 16SO	20		30	
EDB4432BBPA-1D-F-R	IC DRAM 4GBIT PAR 168FBGA	20			50 procured by INFN
LTC2637IMS-LZ12#PBF	IC DAC 12BIT V-OUT 16MSOP	20		40	
MAX3218EAP	IC TRANSCEIVER FULL 2/2 20SSOP	20	1		50 procured by INFN
SN74LVC1G07DBVR	IC BUF NON-INVERT 5.5V SOT23-5	20	2	40	
SI3443DDV-T1-GE3	MOSFET P-CH 20V 4A/5.3A 6TSOP	20	13	100	
BC846BMTF	SMASIGNBIPOLTRANSISTO0.165NPN	20		40	
LTC4364IMS-2#PBF	IC SURGE STOPPER W/DIODE 16MSOP	40	3	40	

TPCB Upgrade and other components

Reference	Description	Qty needed to procure	Qty @ Malargue	Ordered (DigiKey)	STATUS
410-299	PROGRAMMING CABLE JTAG HS3	1			
C3225X7S1H106K250AB	Capacitor 10uf/50V for TPCB filtering	2000	1400		OK (IJC Lab)
5KP36A-TPMSTR-ND	Diodes for TPCB	1200	1900		OK(KIT)
FUSE AXIAL 2A	Fuse for TPCB		109	50	
FUSE AXIAL 10A	Fuse for TPCB		90	100	
CAP X5R 10uF 50V 1206	Capacitor 10uf/50V for TPCB		60		
CAP X5R 10uF 50V 0805	Capacitor 10uf/50V for TPCB		20		
LT1787 CURRENT SENSE	Current sensor for TPCB		94	50	
AD627ARZ	Ampli for TPCB		47	50	
OP-AMP AD820ARZ	OP. Amp for TPCB		50	20	
RES 68K 1% 0,5W 0805	Resistor for TPCB		191		
RES 56K2 0805	Resistor for TPCB		497		

Other components at Malargue

Reference	Description	Qty needed to procure	Qty @ Malargue	Ordered (DigiKey)	STATUS
AD5316 ARUZ (DAC)	DAC		5	10	
ASE 50000MHz LCT	Oscillator		3	10	
BUS HC245	Transceiver		1	20	
DB15-DB15 CONN	Connector		1		
DD29702T D2-1/D3-1	Zener diode		25	20	
ETH+USB CONN	Connector		1		
5YA15 RW182	Flash Memory		9		
CLP10505MRAA	GPS Connector		126		OK
KT11S1SA3M34LFS	SWITCH 1VA 32V		4		
TCA9803DGKT	I2C Bus buffer		3		
BSS138LT1G	MOSFET Trans. N CHAN 50V 220mA		3		
LMR24220TL	Step down regulator		3	250	
1A U37	POWER SCALTER		13		
RCLAMP0524J,TCT TVS	Diode		20		
SPST NC 170 0,5A	Relay Reed		5		
SN74LVC1G06DBVR	IC LOGIC		5	10	
SN74LVC1G17DBVR	IC BUFFER SCHMITTRIG		12	10	
SN74LVC1G38DBVR	IC LOGIC Gate		4	10	
SWITCH 4,46*3,5*3,3MM	SWITCH 4,46*3,5*3,3MM		46		
TPS3808G01DBVR	CIRCUIT SUPERVISOR		2	20	
TRACO TSRN1-2433SM	3V DC/DC Converter		342		OK
FDC5614P	VOLTAGE LEVEL TRANSLATOR		18	20	
VOLTAGE SUPERVISOR 2,7V R140MS	VOLTAGE SUPERVISOR 2,7V		5		

Conclusions

Failures Status

- ✓ Less than 10% of failure on the UUB delivered
- ✓ Big number of UUB with Quality problems, 17%
- ✓ 10+11 = 21 UUB which cannot be repaired (10 at A2F, 11 at Malargue)
- ✓ 146 UUB to be sent

Maintenance Status

- ✓ SDEU Maintenances Procedures here but to be completed
- ✓ Tools available but more need to be procured

Spare parts Status

- ✓ Acceptable number of spare UUB available
- ✓ Most critical components are here
- ✓ More components, ordered
- ✓ Lot of important obsolete or difficult to procure components, procured by INFN