THURLBY THANDAR INSTRUMENTS

TF930 & TF960

3GHz & 6GHz Universal Counters

SERVICE GUIDE

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Input Specifications

Input A

Configurable options

Input coupling:	AC or DC
Input impedance:	1MΩ or 50Ω
Attenuation:	1:1 or 5:1
Active edge:	Rising or falling, or width high or low
Low pass filter:	Filter In (~50kHz cut-off) or Out
Trigger threshold:	Variable threshold for both DC and AC coupling

Input Impedance:	1MΩ//25pF (DC or AC coupled) or 50Ω nominal (AC coupled only).
Frequency Range:	< 0.001Hz to >125MHz (1MΩ, DC coupled). < 30Hz to >125MHz (1MΩ, AC coupled). < 500kHz to > 125MHz (50Ω, AC coupled).
Trigger Threshold:	
DC coupled:	0 to 2V (1:1 attenuation) or 0 to 10V (5:1 attenuation).
AC coupled:	Average ± 50mV (1:1 attenuation) or ± 250mV (5:1 attenuation).
Sensitivity:	Sinewave - 15mVrms 30Hz to 100MHz, 25mV to 125MHz at optimum threshold adjustment.

Input B

Input Impedance:	50Ω nominal (AC coupled).
Frequency Range:	< 80MHz to >3GHz.
Sensitivity:	12mVrms 80MHz to 2GHz, 25mVrms to 2.5GHz, 50mVrms to 3GHz.
Maximum Input Signal:	< 0dBm recommended, +13dBm (1Vrms) maximum.

Input C (fitted to TF960 only)

Input Impedance:	50Ω nominal (AC coupled) in-band. 250kΩ at DC.
Frequency Range:	< 2GHz to >6GHz (typically 1.8GHz to 7.5GHz).
Sensitivity:	25mVrms (–19dBm) 2GHz to 6GHz.
Maximum Input Signal:	< +16dBm (1.5Vrms) recommended. Damage level +25dBm (4Vrms).

External Reference Input

Input Impedance:	>100kΩ, AC coupled.
Frequency:	10MHz.
Signal Level:	TTL, $3V_{pp}$ to $5V_{pp}$ CMOS or 1 to 2Vrms sinewave.

Maximum Input Voltage

Inputs A, B, C, and External Reference: ⚠	30VDC; 30Vrms 50/60Hz with respect to earth ground ⏚

Note that the inputs will not be damaged if subjected to an accidental short-term connection to a 50/60Hz line voltage not exceeding 250Vrms, or 250V DC.

Timebase

Measurement Clock:	50MHz.
Internal Reference oscillator:	10MHz TCXO with electronic calibration adjustment.
Oscillator Temperature Stability:	Better than ± 1ppm over rated temperature range.
Initial Oscillator Adjustment Error:	< ± 0.2ppm at 21ºC.
Oscillator Ageing Rate:	< ± 1ppm first year.
Calibration adjustment range:	> ± 8ppm.

Measurement Functions

Frequency (Inputs A, B or C)

A Input Frequency Range:	< 0.001Hz (DC coupled) to >125MHz
B input Frequency Range:	80MHz to >3000MHz.
C input Frequency Range:	<2Ghz to >6GHz.
Resolution:	up to 10 digits (see below) or 0.001Hz

Period (Inputs A, B or C)

A Input Period Range:	8ns to 1000s (DC coupled)
B input Period Range:	0.333ns to 12.5ns
C input Period Range:	0.166ns to 0.5ns
Resolution:	up to 10 digits (see below)

Pulse Width Modes (Input A only)

Functions:	Width high or low, ratio H:L (high time to low time) or duty cycle.
Pulse Width Range:	40ns to 1000s
Averaging:	Automatic within measurement time selected, up to 50 pulses.
Resolution:	20ns for one pulse; up to 1ns or 10 digits with multiple pulse averaging. 0.01% for Ratio H:L and Duty Cycle.

Total Count (Input A only)

Count range:	1 to 9 999 999 999
Minimum pulse width:	8ns

Frequency Ratio B:A

Resolution:	Equal to the resolution of the two frequency measurements. If the ratio exceeds ten digits, displays six digits plus exponent.

Measurement Time

Selectable as 100s, 10s, 1s or 0.3s. The instrument displays the average value of the input signal over the measurement time selected, updated every 2s, 1s, 0.5s or 0.3s respectively. The hardware captures the count values and continues measuring without any dead time.

Resolution

The displayed resolution depends upon measurement time and input frequency. The basic resolution of period is 8 digits for every 2 seconds of measurement time. Frequency resolution is the reciprocal of period resolution. Usable resolution can be reduced by noise at low frequencies.

Accuracy

Measurement accuracy is timebase accuracy + measurement resolution + 2 counts.

Operating Facilities

Noise Filter (Input A only)

The Filter key controls a low pass filter, with a cut-off frequency of about 50kHz, to assist in obtaining stable readings at low frequencies.

Hold

Pressing the Hold key will hold the current measured value in the display, with the Hold indicator on, until the Hold key is pressed again. The measurement continues in the background when Hold is on. A long press on the Hold key clears old data and restarts the measurement.

Intelligent Power Switching

The unit automatically selects the best available power source of AC adaptor, USB or battery. Intelligent switching avoids discharging the battery overnight when operated from externally switched AC power.

A press-to-measure facility allows a quick measurement to be made by pressing a function select key which will power the instrument up in the corresponding function. The instrument will automatically switch off 15 seconds after the last key-press.

Remote Control

All capabilities can be controlled remotely and measurements read through a USB port.

The instrument can be powered (but the battery cannot be charged) by the USB host.

Interface:	Serial port emulation over USB.
Current consumption:	< 100mA (<5mA if AC adaptor power is present)
Command set:	Instrument specific. TF830 and TF930 compatible.

Power Requirements

The instrument has fixed internal rechargeable batteries and is supplied with a universal voltage external mains adaptor with interchangeable UK, Euro, Australian and US power connectors.

Battery Type:	Three 2500mAh NiMH cells.
Battery Operating Life:	Typically 24 hours
Low Battery Indicator:	‘Lo Bat' shows in display when approximately 10% of battery life remains.
Recharge Time:	< 4 hours
Adaptor Supply range:	85 to 240V, 50 or 60 Hz,
Power consumption:	5W max at DC input to unit; 15VA max at AC adaptor input (charging).

General

Display:	10 digit LCD, 12.5mm high (0.5”). Annunciators show input configuration, operating mode, measurement units and gate time.
Operating Range:	+5°C to +40°C, 20% to 80% RH
Storage Range:	-20°C to +60°C
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2
Size:	260mm(W) x 88mm(H) x 235mm(D)
Weight:	1050 gms (plus 170 gms AC adaptor)
Electrical Safety:	Complies with EN61010-1
EMC:	Complies with EN61326

Safety

Universal Counter

This instrument is Safety Class III according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use).

This instrument has been tested in accordance with EN61010-1 and has been supplied in a safe condition. This instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in a safe condition.

This instrument has been designed for indoor use in a Pollution Degree 2 environment in the temperature range 5°C to 40°C, 20% - 80% RH (non-condensing). It may occasionally be subjected to temperatures between +5° and -10°C without degradation of its safety. Do not operate while condensation is present.

Use of this instrument in a manner not specified by these instructions may impair the safety protection provided.

WARNING!

All accessible parts will be at the same voltage as the outer of the signal input sockets. In particular, note that the shell of the USB connector is galvanically connected to the body of the N-type and BNC inputs and will therefore be at earth ground potential when the USB port is connected to a desktop PC. However, to maintain user safety under all other circumstances it is essential that no input is connected to a voltage above 30Vdc or 30Vrms with respect to earth ground ⏚ which is the limit of Safe Extra Low Voltage (SELV) by IEC definition. Note that although the inputs will withstand short-term accidental connection to an AC line voltage up to 250Vrms, 50/60Hz, users will be at risk if the instrument 'ground' is connected to such hazardous voltages.

The instrument shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair. Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

Do not wet the instrument when cleaning it.

The following symbols are used on the instrument and in this manual.

⎓ Direct Current

⚠ CAUTION – refer to accompanying documentation.
Damage to the instrument may occur if these precautions are ignored.

⊥ meaning that the marked terminal is connected to accessible conductive parts.

Adaptor/Charger

The adaptor/charger supplied has a universal input voltage rating of 100-240VAC, 50/60Hz. It is a Class II (double insulated) device, fully approved to EN 60950-1 (2001), UL 60950 (UL listing E138754) and AS/NZS CISPR:2002 (C-Tick).

⚠ Use ONLY the AC adaptor/charger provided by TTi with the instrument.
Use of any other power source may damage the unit and will void the warranty.

Service Handling Precautions

Service work or calibration should only be carried out by skilled engineers using high quality test equipment. If the user is in any doubt as to his competence to carry out the work, the instrument should be returned to the manufacturer or their agent overseas for the work to be carried out.

This simplified service guide only details the routine calibration procedure and the dismantling of the instrument to PCB assembly level. If a PCB assembly is suspected as being faulty it should be returned to the manufacturer or their agents overseas for repair or replacement. The Parts List gives the part numbers of each PCB assembly, together with the mechanical parts and fasteners that can be easily replaced by the user.

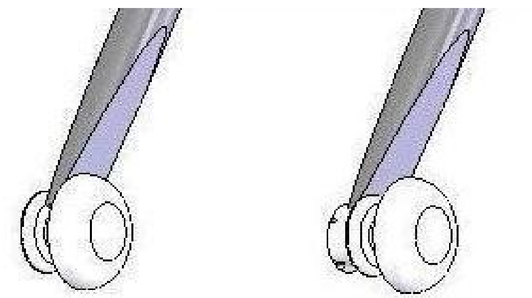
Dismantling the instrument

Note that calibration of the oscillator frequency does not require the instrument to be opened. Refer to the procedure in the next section.

1. Disconnect the instrument from all input signals, the USB connection and the AC adaptor.
2. Unclip the front bezel by gently pulling the centre of each long edge up and forward.
3. The case halves are held together by 4 plastic push-rivets.

Use the blade of a small screwdriver to remove the snap-lock rivets as follows:

First, ease out the head of the rivet using a fine screwdriver blade under the edge of the head (Fig.a). With the rivet head fully out, the body of the rivet can now be eased out with the screwdriver blade and removed completely (Fig.b). To re-assemble, fully re-insert the body of the rivet then push in the head to lock it.



(Fig.a) (Fig.b)

4. Lift off the case upper, leaving the front and rear panels in the base of the unit.
   The instrument can be operated in this condition for fault diagnosis. If adjustment of the C input threshold setting is all that is required, no further dismantling is necessary.
5. Otherwise, disconnect the ribbon cable from the rear of the Main (front panel) PCB.
6. Before removing the rear panel or the Battery/USB PCB, note the position of the grounding spring attached to the USB socket. The PCB is attached to the case lower with 4 screws. To avoid short-circuiting the batteries, do not place this PCB on a conducting surface. When reassembling, take care not to damage the USB spring.
7. To remove the Main PCB from the front panel, first pull the knob off its shaft, lift the Front Panel assembly from the base of the unit and lay it face down on a soft surface to avoid damaging the LCD. Keeping the metal panel flat and upside down, remove the screws holding the PCB to the front panel and lift it off, leaving the loose keycaps in the metal panel. Collect and store the keycaps for reassembly.
8. The C input PCB may be separated from the Main PCB by removing the nut from the N-type connector and pulling the PCB backwards off the connecting pins. On reassembly, align these pins carefully. The washer fits between the flange of the N-type connector and the rear of the Main PCB. Retighten the nut firmly, to put the washer under compression.
9. Reassemble in the reverse order. Take care when reassembling the Main PCB to the metal front panel that all of the keycaps are correctly aligned. Connect the ribbon cable and test the unit for correct operation before reassembling the case.

Frequency Calibration

Equipment Required.

A Standard Frequency Source with accuracy ±0.05ppm or better at a frequency of 5MHz or 10MHz. Ideally use a 10MHz Rubidium source. The procedure below assumes 10MHz.

TF930 and TF960 Reference Oscillator Specification.

Temperature coefficient:	± 1 ppm over the full operating temperature range.
Ageing (first year):	± 1 ppm.
Initial accuracy:	± 0.2ppm (at 23ºC) when new.
Recommended recalibration accuracy:	±0.05ppm

Initial Set-up.

Place the unit in the controlled temperature calibration environment and switch on, running from its batteries. The **Bat** annunciator should show. Allow at least 30 minutes to achieve temperature equilibrium.

If **Lo Bat** is shown, connect the mains power unit and allow the unit to charge, which may take up to four hours. Wait a further one hour after charging completes to allow any internal temperature rise to dissipate.

Manual Reference Oscillator Frequency calibration.

Connect the standard frequency signal to the A input.

If the unit is on, press **Operate** to switch it off.
Hold down the **Input A/B** key and press **Operate**.
Release **Operate** when the display appears, then release **Input A/B;** the display should show
Cal ? Y n.
Press the left hand **Measurement Time** key to select Yes.
An annunciator **C** should be flashing in the display.
In calibrate mode an extra digit of resolution is shown (to speed the process), but note that the last digit may be in error by more than one count.

Select 50Ω **Impedance** (with the default AC **Coupling**) and centre the **Threshold** control at the **AC** marker. The display should show the frequency of the standard source, subject to any pre-calibration inaccuracy.
If the reference signal is large it may be necessary to select the 5:1 **attenuator.**

The calibration setting is adjusted by pressing the **Frequency** and **Period** keys.
The **Frequency** key raises the oscillator frequency and makes the displayed value lower.
The **Period** key lowers the oscillator frequency and makes the displayed value higher.
The amount of adjustment for each press depends on the Measurement Time setting.

With 0.3s **Measurement Time** selected, note the difference between the reading and 10.00000MHz and press either the **Frequency** or **Period** key to get a closer result. Each step moves the oscillator by about 0.2ppm (2Hz at 10MHz). Repeat as needed, aiming to be within about 4Hz, then move to the next step.

Set the **Measurement Time** to 1s and repeat the process. The adjustment per step is now a decade smaller and multiple presses may be needed. The measurement restarts after each set of key presses. It will take a few seconds for the reading to stabilise because of the settling time of a filter on the control voltage. Aim to be within about 0.5Hz and then move to the next step.

Set the **Measurement Time** to 10s and wait for the measurement to complete (**Measure** stops flashing and an extra digit appears). Check that the reading is within ±0.05ppm (0.5Hz), making further adjustment if needed (waiting for Measure to stop flashing after each adjustment). Each key press moves the oscillator about 0.002ppm (2 counts in the last digit).

Although the calibration value can be set to this precision, this is more accurate than is necessary, considering the medium term stability of the oscillator. The initial accuracy is specified at ±0.2ppm on despatch from the factory, but after a unit has aged for a year or more, it is reasonable to set the calibration value to within ±0.05ppm. This is typical of the variation over normal room temperature changes during the course of a day.

Finally, press and hold down the **Width** key for a few seconds to store the calibration value in EEPROM.
Hold the key down until the C annunciator stops flashing and stays off.

Note: To exit calibration without saving the new value, simply press **Operate** to switch off.

Press **Operate** to switch the unit off, wait a few seconds and then press it again to turn the unit back on.
Select 50Ω **Impedance** (and if necessary 5:1 **attenuator**). Set the **Measurement Time** to 10s.

Check that the reading is the same (within 1 count) to prove that the new calibration value has been stored.

If desired, set the **Measurement Time** to 100s, and (after Measure stops flashing) record the final reading.

C Input Threshold Adjustment

Introduction

The prescaler used in the C input will self-oscillate if no signal is applied. To avoid distracting the user a signal level detector circuit senses the absence of a useable input signal and disables the divider to show 0.0 on the display. There is a preset adjustment in this circuit, which might possibly drift with time. If the threshold is too low, then the unit will show a random count around 7GHz whenever the C input is selected without a signal. If the threshold is set too high, then the usable sensitivity of the input is impaired.

Equipment required

2 to 6GHz signal generator with reasonably accurate calibrated level around 5 to 15mV.
A microwave grade N-type to N-type coaxial lead. (Do not use a BNC type with adapters).

Procedure

To adjust the setting, first dismantle the unit to the stage of removing the top cover. Identify the C input PCB, the variable adjustment, a two pin link LK1 and a surface mount LED near the link.

With no signal applied, switch the unit on and select the C input. If 0.0 is displayed, short together the two pins of LK1. The unstable count should appear; if not, then there is a fault present.

Apply a CW signal at 3GHz and a level of 6mV. Using a suitable trimming tool, turn the variable adjustment clockwise until the LED lights (and a count appears on the display). Then turn the variable adjustment **slowly** anti-clockwise until the LED just extinguishes.

Increase the signal generator level until the LED lights and a count shows; this should be before 12mV. The count should be correct by 15mV. Decrease the signal generator level to 4mV and check that the LED extinguishes and the display shows 0.0. Check at other frequencies across the range 2 to 6GHz that the LED remains off at a signal level of 4mV.

Note

This is a general purpose setting which will achieve rated sensitivity, but at some frequencies the level detector will permit a count with a signal level below that needed to produce a correct count.

Some customers may prefer a higher threshold setting, so that a count does not show until it is correct. This setting can be performed at the customer’s preferred frequency, but this may possibly mean that the unit does not meet its sensitivity specification at other frequencies.

Diagnostic Notes

This instrument uses many small surface mount components in critical high frequency circuits. Component level fault finding and repair is not possible and service is normally performed by identifying the faulty PCB assembly and returning it to the manufacturer or their field service agent for repair or replacement. The only field repair possible is the replacement of the rechargeable battery cells. The following notes are intended to help in identifying which of the PCBs is faulty.

AC Adaptor

The output voltage of the adaptor can be checked with a DVM: the outer sleeve is the negative terminal and the voltage should be around 5.2 to 5.3V.

Initial Checks

First check that all keys are free to operate; if any one is stuck down, then the unit cannot correctly identify keystrokes.

Now remove the top cover of the instrument as described up to step 4 of the disassembly procedure above.

First try disconnecting and then reconnecting the ribbon cable from the back of the main PCB. Inspect the insulation displacement connectors and check they are clamped together tightly. If intermittency is suspected, remove the Charger PCB and check the solder joints on the transition header.

Otherwise, identify the faulty subsystem by checking the following items in order.

Batteries

Measure the voltage of each cell; they should be similar and between 1.0V (discharged) and 1.45V (fully charged). If any cell delivers below 0.5V it is probably damaged and all three cells must be replaced, either by field repair (see below) or service exchange.

There is a self resetting fuse in series with the battery. This component is a last resort protection against fire and any failure indicates that another major fault has occurred.

⚠ Note in particular that this component MUST NOT be hand soldered as that will almost certainly cause an internal short circuit which would negate the protection.

If the cells are charged, but the unit will not function then the fault is almost certainly on the main PCB. To check, use a DVM to measure the battery voltage on the charger PCB between the test points T0V (to the right of the USB socket) and TV (in front of the large gold area on the PCB). Then measure the voltage on the main PCB between T0V (in the bottom left hand corner) and the hole for pin 1 of the unfitted power socket on the right hand edge of the PCB. If the same voltage is present here, then the fault lies on the Main PCB.

Battery Charger

Connect the AC adaptor to the unit and switch it on. Check that the input voltage appears between the test point T0V (to the right of the USB socket) and the input to D2 on the rear-most of the three gold heatsink areas.

There is a 2A surface mount fuse in the input circuit to this point. The AC adaptor supplied with the instrument does not have sufficient current capacity to blow this fuse, so if it is open circuit this indicates that an incorrect AC adaptor has been attached to the unit. Major consequential damage should be assumed, so replace the whole PCB; do not just replace the fuse.

If the battery voltage is below about 3.3V the charger should start automatically, and the yellow lamp should show on the panel. The charger may also be started by pressing SW1 on the PCB. If the charger is active, it will be possible to feel that D2 and Q1 are warm within a few minutes. If the charger is running but the lamp is not showing then the fault might be in the drive circuit, the ribbon cable connections or the LED itself.

If a charge termination fault is suspected, return the charger PCB for replacement as it is not safe to have the batteries continuously charged. There are four different charge termination circuits and an immediate recharge prevention circuit: do not attempt diagnosis.

USB faults

Use the AC adaptor to power the unit while attempting to diagnose USB problems.

Many USB problems are actually PC configuration issues. The interface device on the charger PCB is a USB to serial converter: remote control messages are sent to the main system processor on the Main PCB through an internal serial link. The counter appears as a COM port to the PC; this is not a "virtual" COM port it is a real one that happens to be connected by a USB cable. Port properties such as the baud rate must be correctly configured from the PC end of the link (details are in the User Manual).

The COM port number allocated is chosen automatically during the driver installation. The BIOS of some older computers prevents proper operation of a USB connected port if the number allocated is COM3 or COM4; if this happens, use Device Manager to manually configure it to COM5 or higher. Note also that some old PC software will not communicate with ports above COM15.

The interface device on the Charger PCB is responsible for the USB enumeration. If the PC cannot detect the counter as a USB device, then the fault lies here. The switching logic will not take power from the USB unless the port has been properly enumerated by the host PC.

If the PC can detect the USB device, but functional control of the counter is not possible then (provided the baud rate etc. are correctly configured) the fault lies with the processor on the Main PCB, or possibly on the interconnection between.

Note that changing the USB/Charger PCB will change the instrument's USB serial number, so it will appear to be a different unit to any PC, which will seek to reinstall the drivers.

Functional Faults

If there is a fault in any aspect of the operation of the A or B inputs, then the Main PCB should be returned for repair or replacement.

For a TF960, if operation of the A and B inputs is correct, but the C input is faulty, then further checks may be carried out to determine the location. It may also be worth checking the soldering on the interconnections.

Switch on the unit and select the C input.
Note: if the unit has been dismantled and the Main PCB is hanging loose, take care not to accidentally press one of the keys and change the operating mode while handling the board.

With no signal applied to the C input, short together the two pins of LK1 on the C input PCB. An unstable count (broadly in the region of 7GHz) should appear on the display.

If a count appears, then the circuits on the Main PCB are functioning correctly and the fault lies on the C input PCB. It is possible that the signal detector threshold setting is incorrect. If suitable test equipment is available, attempt the threshold setting procedure below. Otherwise return the C input PCB for replacement.

If no count appears, then return both PCBs for repair or replacement.

Battery replacement

The battery consists of three 2.5Ah NiMH cells. They are conservatively constructed and should provide hundreds of charge-discharge cycles. Extended storage or use in high temperature environments may reduce cell life. If it appears that the discharge time has reduced significantly, or if the cell voltages have become mismatched, then the cells may be replaced.

⚠ Replace all three cells simultaneously, using new cells of the same make and type.
Use only A or AF size 2.5Ah NiMH (Nickel Metal Hydride) rechargeable cells.
Do not use AA size cells. Do not use Nickel Cadmium cells.

Remove the top cover of the instrument and disconnect the ribbon cable from the rear of the Main PCB. Disconnect the AC adaptor.

Remove the old cells from the unit by cutting the tags attached to the battery and then the tie-wraps holding them to the PCB. Cut the tags; do not attempt to unsolder them. Tape up the cells to avoid accidental short circuits and dispose of safely.

⚠ Do not incinerate the cells, or place them with domestic waste.
Dispose of them in accordance with local regulations and facilities.
These cells are recyclable.

Early units may be fitted with cells having tags with connecting holes; these are attached to the PCB with lengths of wire. Current production cells have tags without holes. These are attached using standard 0.025” square connecting posts taken from a SIL pin header. Clean up the connections and fit new posts if required.

Note that there is a thermistor near the centre cell which is used by the charger circuit to sense its temperature. Place a small amount of heatsink compound over the thermistor to ensure good thermal conductivity.

Place the cells on the PCB, making sure that they are all correctly oriented (they all point in the same direction) and that the tags are aligned with the correct connecting pads. Secure the cells to the PCB with tie-wraps (only sufficiently tight to hold the cells – do not bend the PCB).

Finally wrap the tags around the 0.025” square posts and solder as quickly as possible. It is important not to overheat the seals of the cell.

As quickly as possible, confirm the polarities by using a DVM to check that the voltage between the test points T0V (to the right of the USB socket) and TV (in front of the large gold heatsink area) is equal to the sum of the cell voltages – it should be between 3V and 4V.

Reattach the ribbon cable to the Main PCB. The unit should now be functional.

Attach the AC adaptor and provide power; it the cell voltages are low charging will start automatically, in which case wait a few minutes until the cells are charged past the threshold.

Test the charge termination circuits as follows:

> Press SW1 to start charging, then briefly short LK1: charging should stop.
> Press SW1 again, then briefly short LK2: charging should stop.
> Place a shorting link across LK3 (to run the timer at test speed)
> Note the time and press SW1 to start charging; charging should stop in 45 to 55 secs.
> Wait a further 60 secs then press SW1 again; charging should not restart.

Disconnect the AC power and remove the test link across LK3. If any of these test fail, return the PCB for repair or replacement.

Re-apply power, press SW1 and monitor the first charging cycle by watching the yellow charge indicator on the front panel. Charging must automatically stop within four hours. At the end of the charging cycle check that the cell voltages are equal within ±50mV and that the temperature of the three cells feels similar to the touch.

If charging does not automatically stop, then it should be assumed that the old cells were destroyed by a faulty charging circuit and the whole PCB should be returned for repair.

Parts List

Part Number	Description	Position
Common Items		
51151-0820	AC ADAPTOR UNIV 5.2V/1A DC	(WITH CONNECTORS)
44813-0410	PCB ASSEMBLY – CHARGER & USB - TF	(COMPLETE WITH 10W CABLE)
20010-0258	RIVET SNAPLOK 3.6Dx2.7-3.6L GREY	FOR CASE
20010-0259	RIVET, SCREW TYPE	FOR FEET
20073-9801	SCREW No.4x1/4 Plastite	CHARGER PCB TO CASE
20234-0100	SCREW M3x6 C/W WASHER	MAIN PCB TO FRONT PANEL
20662-0590	FOOT - BLACK RBS-1 - S/ADHESIVE	
33143-0310	FOOT PLAIN (ROUND) BENCH CASE 2	
33143-0320	FOOT BAIL HOUSING BENCH CASE 2	
33143-0330	FOOT TILT BAIL BENCH CASE 2	
31711-0210	BEZEL - BENCH CASE 2	
33536-4380	CASE UPPER BENCH CASE 2	
33536-4390	CASE LOWER BENCH CASE 2	
33331-9790	REAR PANEL	
37113-2183	KEYCAP 8X6MM GREY3 TF	
37151-0483	KNOB 21MM D-SHAFT GREY3	
38611-0010	COLLAR – BNC – FOAM	
20653-0204	CABLE TIE 100 x 2.5mm	FOR BATTERIES
22010-0500	BATTERY 1.2V2.5Ah NiMH AF TAG	
35358-0580	EARTHING SPRING USB	SUPPLIED WITH CHARGER PCB
48511-1110CD	CD – UNIVERSAL PRODUCT DATA	INCLUDES USB DRIVERS
TF930 Items		
33331-4690	FRONT PANEL – TF930	
33331-9780	OVERLAY – FRONT PANEL – TF930	
44813-0400	PCB ASSEMBLY – MAIN – TF930	
48581-1400	INSTRUCTION BOOK TF930	
TF960 Items		
33331-1690	FRONT PANEL – TF960	
33331-1700	OVERLAY – FRONT PANEL TF960	
44813-0430	PCB ASSEMBLY – MAIN – TF960	
44813-0440	PCB ASSEMBLY – INPUT C – TF960	
48581-1440	INSTRUCTION BOOK TF960	

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