

CATFIRE



CFTFU-X16

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CATFire CFTFU-X16 Quick operation reference

Go to main display:  (Hold 2Sec+)=>

U001 F001 V18.3
DISARMED

Adjust display contrast:  (Hold 2Sec then keep holding) &  / 

Set unit address:  ,  /  =>

Select menu item
Addressing

=>  ,  /  =>

Unit Address
UA: 001

=>  =>

Set unit address:
UA: 001

=>  /  ,  =>

Unit address:
UA: 039

Set firing address:  ,  /  =>

Select menu item
Addressing

=>  ,  /  =>

Firing Address
FA: 001

=>  =>

Set firing addr:
FA: 001

=>  /  ,  =>

Firing address:
FA: 039

Cue test:  ,  /  =>

Select menu item
Cue testing

=>  =>

Do cue test?
<SET> to begin

=>  =>

TESTING CUES
TESTING CUES

=> (Wait)=>

U001 F001 V18.3
< NOT DISARMED >

(Wait)=>  /  =>

123456789 ₁ ⁰ ₁ ¹ ₁ ² ₁ ³ ₁ ⁴ ₁ ⁵ ₁ ⁶
0000 ! 0 0

Battery test:  ,  /  =>

Select menu item
Battery testing

=>  =>

Do load test?
<SET> to begin

=>  =>

TESTING BATTERY
TESTING BATTERY

=>  /  =>

Peak amps:
80A

=>  /  =>

Battery result:
EXCELLENT

Remote Arm UNLOCK:  ,  /  =>

Select menu item
Remote arm lock

=>  =>

Arming lock:
LOCKED

=>  =>

Set arm lock:
LOCKED

=>  /  =>

Set arm lock:
UNLOCKED - TEMP

=> 

Local arming (trigger operation):  ,  /  =>

Select menu item
Local arming

=>  =>

ARM System?
<SET> to ARM

=>  =>

ARM System
NO

=>  /  =>

ARM System
YES

=> 

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CATFire – CFTFU-X16 Firing unit

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS, FEATURES, FIRMWARE AND ITS FEATURES, SOFTWARE AND ITS FEATURES, DOCUMENTATION AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Errors and Omissions Excepted (E&OE).

Revision history

Revision	Changes
1	First; Support hardware version 3; Firmware version 16.
2	Updated “Features of your unit” with weight and dimension information.
3	Business address change

About your firing unit – intended usage



Keep children, pets and animals away from this unit.



Only competent adults should operate this unit.



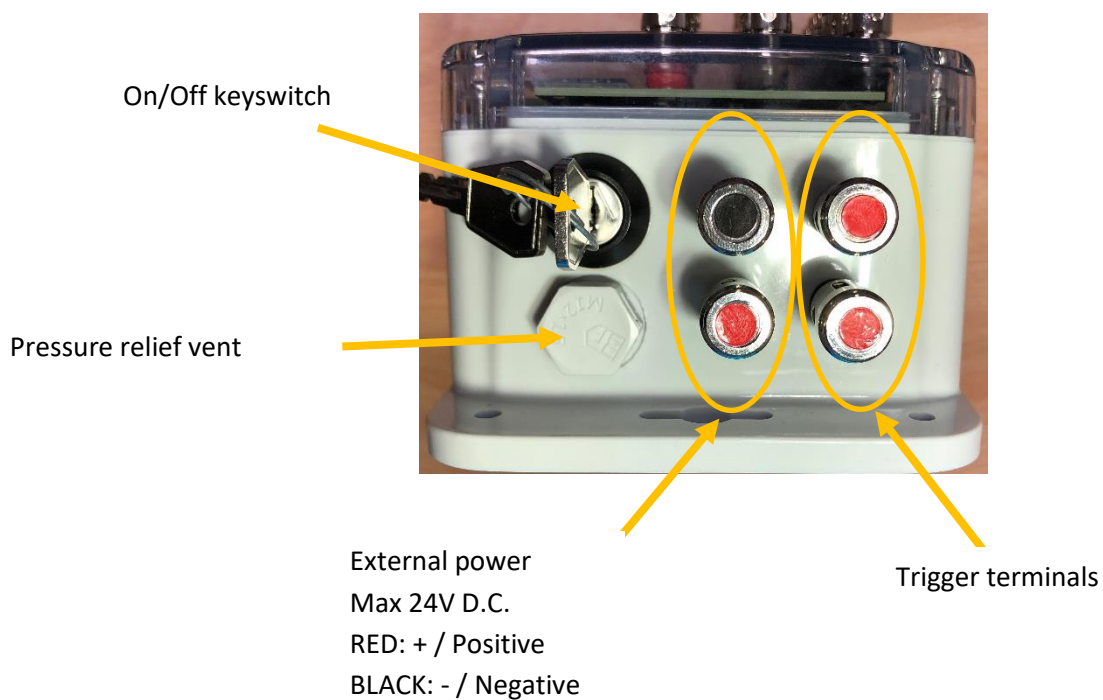
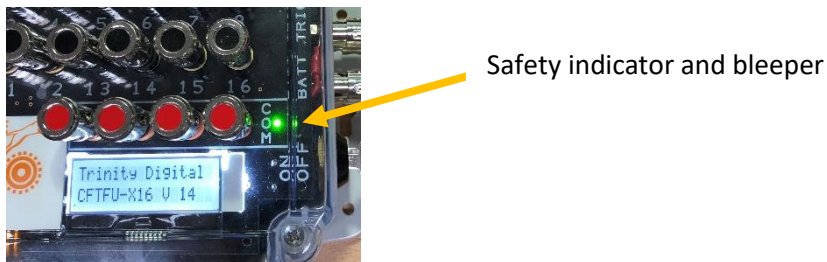
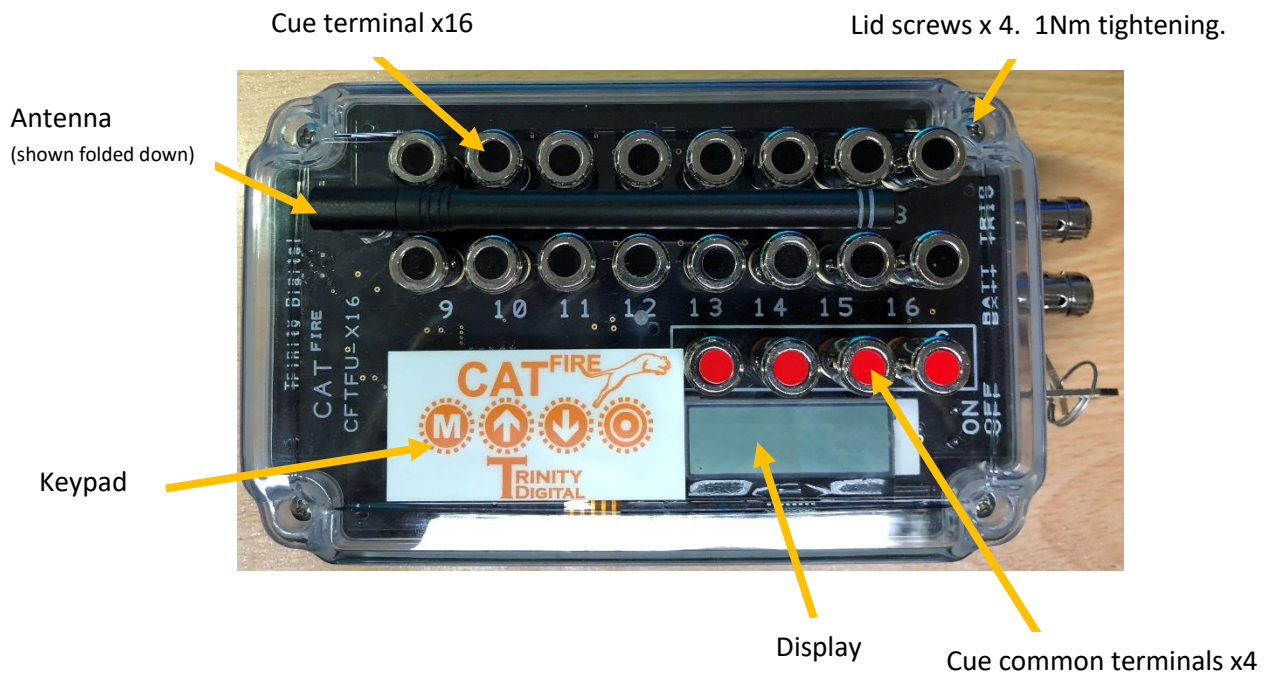
Do not operate this equipment if you are unwell or under the influence of drugs or alcohol.

This digital firing unit is primarily intended to be used to ignite fireworks and other pyrotechnic material for display, re-enactment, theatrical and battle simulation purposes.

Throughout this manual when we mention pyrotechnics we are also referring to fireworks.

The unit may also be used to switch power to devices like relays, lights or motors etc.

Familiarising yourself with the CFTFU-X16



9v battery pair.

Up to 3 pairs can be installed for more run time or firing amps.



Polarity indicators

Install the batteries by first checking polarity, then angling the battery base inwards under the clamp, finally pushing the battery down.

The polarity of every battery is the same.

Add pairs of batteries, a pairing is shown in green. Up to 3 pairs.

Opening & Closing the lid / Condensation

The unit has a high IP (Ingress Protection) rating of IP66.

The enclosure screws must be tightened to a torque of 1Nm for this purpose.

Always tighten diagonally opposite corners first to ensure even pressure is applied across the enclosure lid.

When opening, turn upside down to shake out any water from the screw holes first.

When closing always wipe clean & dry the sealing surfaces.

If the unit is opened in humid air, when re-sealed, the moisture content in the (now trapped) air can, in some conditions, condense on the inner surfaces of the enclosure.

This is expected, perfectly normal, and the electronics are protected (tropicalised) for this very condition.



This is often seen where the unit is under high temperature (so the moist air inside is even hotter - like the inside of a car), the outer walls relatively cooler – especially if there is a breeze over the unit – the moist air will condense on the relatively cooler inner surfaces.

The unit contains a Pressure Relief Vent with an osmotic membrane, this prevents moisture from being sucked into the unit as atmospheric pressures change and allows the lid to be opened easily.

Storing

If the unit is not to be used for an extended period, we recommend you remove the batteries, leave the lid loosely placed, optionally place drying crystals inside of the unit too.

Types of igniters

It is intended to work with the following types of igniter:

- Electrical matches (also known as e-matches, i-matches or pyrotechnic igniters) that typically require a 1 ampere firing current and have a characteristic resistance typically of 2 ohms. Such igniters are well used in this industry and are familiar to trained operatives.
- “Solar Flare Igniters” (SFI) [™] which are a safer non-pyrotechnic article used to ignite quick match or similar fuse.
- Talon[™] igniters typically used to attach to Visco[™] fuse on consumer fireworks for hobbyist use.

Each cue of the unit can deliver up to 5 amperes of current, this depends on the capability of the power source.

Connecting igniters

Igniters have two connections, electrical current passes through the electrical loop and causes the igniter to operate.

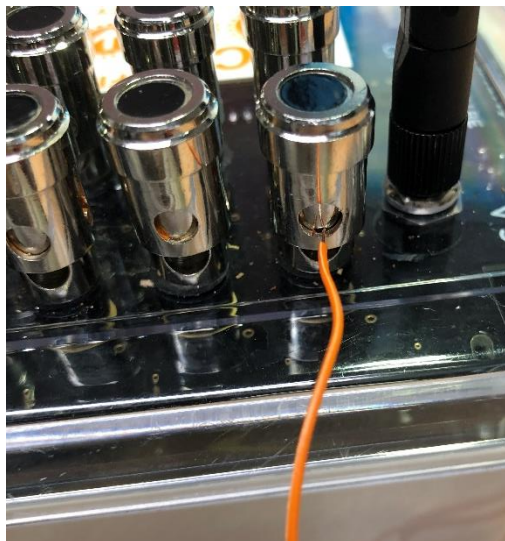
Typical igniter



Showing Talon® igniter with its two connections at the end of the wire.

The igniter wires have no 'polarity' – there is no + (positive) or – (negative) here, one will connect to a cue terminal 1 to 16, the other to a COM terminal, as described as follows.

Igniter connection



STEP 1: From the above picture, press down on the cue terminal. Insert one of the igniter wires. Release the terminal – spring force will clamp the wire.

NOTE: Ensure that bare wire does not touch anything else.

STEP 2: The other end of the igniter wire (the 'return wire') should connect to one of the COM terminals.

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NOTE: COM terminals are all the same, electrically, connecting to any will do.

The following picture shows a unit with igniters connected to all cues, it is perfectly okay to connect several igniter return wires together to the same COM terminal.



Simple switches

Each cue of the unit can operate as a simple on/off switch for the control of relays, lights or motors etc.

Each cue can deliver up to 5 amperes of current.

You should always ensure that the supply voltage to the unit matches the required voltage of the attached devices.



Testing functions, intended to test igniters, will produce unpredictable results when used for general switching purposes.



Testing function of the unit will put a small current through these cues and could cause inadvertent activation of the attached equipment.

Supply voltage

The unit typically operates from pairs of 9v batteries, producing up to 18 volts.

Up to three pairs can be installed, with best quality alkaline batteries up to 18 amperes can be delivered.

Adding additional pairs will increase the total current delivery and / or extend the run time of the unit.

Use the load test function to identify the peak current delivery and battery condition of the installed batteries.

Additionally, the unit can be supplied from an external DC power source, from 12 to 24 volts, run time is effectively unlimited in this case and peak amps can be up to 80A across the unit.

Both supply methods may be used at the same time, the highest voltage source will 'win', but the lower voltage source may be useful for backup purposes.

External power source



When power is supplied to the unit using its external supply terminals these terminals are live and accessible.
Igniter lead wires coming into contact with these will cause ignition.



Always disconnect wires from the battery FIRST before altering wiring connections on the firing unit terminals, this will help you to prevent short circuits which could cause a fire or explosion.

The external power source terminals are located on the side of the unit, immediately next to the key switch.

Connect a DC power source from 12 to 24 volts, for example using a car battery or a 12 V SLA type battery.

Disconnect the wires from the battery FIRST to avoid short circuits.

Connect the – (negative) wire to the BLACK terminal on the unit.

Connect the + (positive) wire to the RED terminal on the unit.

Ensure there are no shorts between the terminals or wiring.

Finally connect the wiring to the battery terminals, again observing + and – polarity.

Power saving features

The CFTFU-X16 contains extensive power saving features.

These features activate when the unit is not interacted with at all.

When any interaction with the unit occurs, the power saving features are turned off, the unit runs at full power until interaction stops. For example, when armed, when running tests, when a button is pressed or there are radio communications with a remote firing computer.

This latter condition catches people out – leaving a remote firing computer communicating with firing units will keep units on full power and run down their batteries.

Expected run time

Many factors affect run time, including battery type and age, temperature and how you use the unit.

The following table indicates expected run times in typical situations at 20 degrees Celsius.

Power source	Run hours active	Run hours power saving***
1 Pair 9v Battery	6	18
2 Pair 9v Battery*	10	48
3 Pair 9v Battery*	14	72
12V SLA (7Ah)**	40	192

* Adding pairs to increase run time, not firing amps. You should keep in mind that when adding pairs of 9v batteries purely to increase firing amps, the expected run time is as per 1 pair.

** And series-wired giving 24v.

*** Unit switched on, not being interacted with, firing computer not operating.

Safety considerations



This unit uses low DC voltages from 12 to 24 volts.
DO NOT supply AC or higher voltages.

Although these very low voltages are used, when handling the unit in wet conditions you should exercise caution to ensure power is OFF and any external supply is disconnected.

NEVER work with pyrotechnics while the unit is switched on.

Ensure you are well away from the pyrotechnic material when the unit is on, even during testing.

When arming the unit ensure you are well away from the pyrotechnic material - walk away from the firing site.

When supplying the unit with power using its external battery terminals ensure that power source is OFF when working on the unit – if igniter wires come into contact with these terminals it could cause ignition.

Untrained operators / Hobbyists

Many fireworks suppliers offer training days to help familiarise yourself with fireworks and how to enjoy them safely and we highly recommend you attend one of these informative and fun days out.

Always set up your fireworks properly in accordance with the manufacturer instructions and best industry standard practice, electrical connection to the firing unit is the last thing to be done, then walk away.

Be aware that some fireworks are angled / fanned, so working at the side of fireworks may not be the safest location, the safest location to place the firing unit is usually in front of the fireworks they are attached to.

Use long leaded igniter wires allows you to site the firing unit away from the fireworks it is connected to and allows you to make those electrical connections, and run tests, at a distance.

Always be aware of “where your head and hands are” at all times.

How this unit works

This unit uses electronics and software to control electrical pulses which cause an igniter to get hot and/or burst into flame, the heat igniting the pyrotechnic material to which it is attached.

This unit is a rugged and weatherproof design (IP66), though not submerged in water or subjected to strong jets of water.

It is intended to be used from -20 to 60 degrees Celsius with 90% relative humidity non-condensing.

It is not impervious to damage from things like explosion, fire or misuse, and as with any electronic or software product, could malfunction.

Over several years, every effort to design a safe and reliable system has been made, this unit contains many fail safe elements.

These statements are not intended to frighten you but to hammer home that safe working practices are essential when working with electronic devices around explosive material.



Never use a unit that looks damaged or is behaving in a way you are not expecting it to. Turn it off and walk away from the danger immediately.



The unit must not be used in an area where static electricity is expected or present.



The unit must not be used when an electrical storm is expected or present.



The operator must wear suitable protective clothing that is also safe work wear around explosive material and electrical devices.



Always REMOVE the power key switch when working on the unit.
This prevents the unit from testing, arming and firing.



Keep radios, mobile telephones and external power sources away from the unit and pyrotechnics.



Disconnect and turn off any external power you may be supplying to the unit when working on the unit.

Best practice for setting up

Best practice tells us to work progressively away from the danger.

It is intended that the firing unit be placed away from the pyrotechnic material and shielded from heat, burning material and explosion. Use of long leaded igniters assists here.

Ensure the power is off and the key is removed from the CTFU-X16 unit.

Igniter connections

After rigging of the pyrotechnic material, connect the igniter to the material.

Then, moving away from the material, connect the igniter lead wires to the CATFire cue terminals.

Once all material is connected to the unit, ensure that no personnel are near the material but are aware of what is happening, and then perform diagnostic testing.

NOTE: If diagnostic testing indicates a problem, turn OFF the unit and any external power before making adjustments.



NEVER APPROACH PYROTECHNIC MATERIAL WHEN THE ELECTRICAL CONNECTION TO THE CTFU-X16 HAS BEEN MADE. ALWAYS DISCONNECT.

Radio communication

For best communication you should ensure that the antennas on every CFTFU-X16 and the CFCIU-1 interface unit are pointed upwards.

Where practical ensure that every antenna is at equal elevation and clearing any obstructions on site (racking etc.). Ideally units should be raised from ground level – this helps to maximise range and clear any unlevel ground between the CFCIU-1 and the CFTFU-X16's that may obstruct signals.

Tip: CFTFU-X16 units do not need line of sight between each other as they do not communicate with each other. The communication is between the CFCIU-1 and the CFTFU-X16 units.

Keep within the communication distances specified for CATFire (800m line of sight).

Where obstructions are inevitable (trees etc.) radio range will be reduced. Metal and structures such as buildings can block the signals altogether so avoid these.

For more information on radio communication refer to our document "Understanding radio communication" downloadable from our web site or contact support@trinitydigital.co.uk to obtain a copy.

Cleaning your unit

The unit is IP66 rated and while weatherproof we do not allow jet washing or submerging.

You may use a hose with a soft spray pattern to remove the bulk of dirt or debris – but make sure the unit lid is closed properly first.

Clean the unit with a soft damp cloth that has been rinsed in a weak soapy washing up solution.

Use a soft brush to brush away debris from the terminals.

Air or cloth dry the unit.

Features of your unit

1. IP66 weatherproof enclosure.
2. Tropicalised, modular electronics structure, provides future upgrades and easier maintenance.
3. Firmware updating via radio.
4. On/off key switch, removable in the off position only.
5. Sixteen output (electrical cue) digital firing unit.
6. Many power choices: 12 to 24v DC external power supply or 18 VDC nominally when using internal 9v batteries.
 - a. Up to 3 pairs of internal batteries for longer run time or higher current loads.
 - b. Power externally but use internal batteries for backup.
7. 5 Ampere peak per cue.
8. Battery load test function; advanced battery diagnostic.

9. Trigger input.
 - a. Nominal apparent resistance of 12 ohms.
 - b. Maximum test current 50mA into the Trigger input.
 - c. Trigger current 0.5 ampere, minimum 9 volts, maximum 60 volts.
10. Firing switch tests detects faulty switches.
11. Electrical cue tests with smart resistive continuity check.
12. Remote Arm lock / unlock – prevents remote arming of the unit for safe working.
13. LCD display with 16x2 lines with backlight; adjustable contrast.
14. Advanced 70 channel hopping radio with 800m range line-of-sight with encrypted communication.
15. Four tactile button key panel for control and configuration.
16. Unit can be fired manually using trigger or under remote control via radio.
 - a. When radio controlled, trigger becomes a wired disarm feature.
17. A local script for trigger operated firing.
 - a. Permits rapid firing and automated advancement during the program.
 - b. Also allows cues to be turned on/off as switches.
18. 1ms timing interval precision.
19. Fire any number and any combination of electrical cues at any time.
20. Advanced adaptive firing logic increases reliability of firing.
21. Cues may be used for firing or on/off function to control attached devices.
22. Event logging.
23. Heartbeat bleeper and safety indicator lamp and discreet operation option.
24. 64 safety groups for advanced firing control during firing.
25. Dimensions and weights:
 - a. 1080 grams.
 - b. 235mm (incl mounting feet) x 112mm x 101mm (LxWxH)

External power to the unit

Apply DC voltage 12 to 24V to the power terminals.

Positive + is to be attached to the RED terminal.

Negative – is to be attached to the BLACK terminal.

We recommend using fine stranded flexible 2.5mm² / AWG #14 wire. You may use less if the run is short. It helps if the ends are soldered to prevent the strands fraying.

We recommend using flame retardant cable.

Depending on current delivery capability of the external power source, several CFTFU-X16 units may be powered by it, this is especially true when using Sealed Lead Acid (SLA) batteries.

We recommend performing a load test to check that the supply and cabling is good.

Radio

This unit communicates with the master control console using a 70 channel, hopping radio system in the 868MHz band (863MHz to 870Mhz).

Encryption is provided for additional security.

The unit can transmit comfortably to 800m line of sight.

Antenna



The antenna is a grounded and sensitive device. Never allow wiring or other metal objects to come into contact with the antenna, short circuit or other malfunction could occur.

The antenna as supplied is an 868MHz dipole omni-directional antenna.

The antenna should be fixed to the threaded port finger tight only, do not overtighten.

The antenna should always be pointed vertically upwards.

If the unit is positioned other than horizontal and flat on its base, the antenna can be gently rotated, the hinged joint allowing for the antenna to always be put into the vertical upright position.

Keep metal objects and other obstructions away from the antenna. This includes placing the unit on metal surfaces or near to metal structures.

If necessary, for best reception, raising the unit off the floor will increase signal quality.

If radio control is not required then simply remove the antenna by unscrewing it from its port.

States of the unit

The unit has different 'states' of operation, these are broadly described here.

State	Purpose
POWER OFF	The unit has no power. No firing will occur, no function will operate.
SELF TEST	After power on the unit performs a diagnostic of the circuitry. If the self test fails the fault is shown and the unit will not operate.
DISARMED	The unit is on, the unit is in its safest operating state. The visual green lamp flashes every 3 seconds, unless in 'discrete mode'. The heart beat bleeper bleeps every 3 seconds, unless in 'discrete mode'.
ARM UNLOCKED	The unit is DISARMED but can become ARMED at any time by a remote master.
NOT DISARMED	The unit is not armed but does not consider itself in a disarmed state. This occurs after testing or after arming ends. When this condition clears the unit will typically enter DISARMED state. If this state shows, when unexpected, it has detected a voltage anomaly on its cue power terminals, check there is no short circuit to these.
ARMED	Unit is armed (either by local or remote radio command).

	Cues may fire. This is the most 'dangerous' state and approach the unit and material connected to the unit with extreme caution.
--	---

Safety indication

The unit contains an audible heart beat bleeper which beeps briefly every 3 seconds.

It also contains a bright green lamp that flashes.

The unit considers itself in a DISARMED condition when the lamp flashes and the heart beat bleeper operates.



When *discreet mode* is enabled neither the green lamp nor the bleeper operate!



Rule of thumb: When you do not hear the bleeper or see the green lamp
APPROACH WITH CAUTION.

LCD backlight

The LCD display contains a backlight illumination.

Due to power conservation the display is only illuminated at power on or after any key press.

The illumination is turned off after a short interval of button inactivity.

LCD Contrast adjustment

Sunlight, temperature and age of the display can affect its contrast making the characters harder to see.

You can adjust the contrast easily as follows:

1. Hold the  button down for two seconds and continue to do so
2. Use  &  to adjust the contrast
3. Release buttons when done

NOTE: Holding  button in this way will also cancel any sub menu you are in and return to the MAIN screen.

ARMing

Arming the unit is the act of putting the unit into a mode where it can readily fire, it is the most 'dangerous' of conditions as some of the safety mechanisms are disabled and power is applied to the cue terminals.



Remote unlocking

The unit will NOT allow itself to be armed remotely (via the radio) until unlocked for this purpose.

This feature enables the operator to set up the unit, connect to power and perform tests with confidence that the unit cannot become armed by a remote operator unaware of your presence.

Remote arm unlocking can be temporary (until power cycle) or permanent if unlocking before showtime is inconvenient.

See later for unlocking the ability of the remote firing computer to arm the unit.

Local

The unit can be 'locally' armed using the menu.

Once armed in this way, the trigger is used to perform firing or switching operations without the need for a remote firing computer to be operating.

The unit stores a script and, on each trigger input, a step of the script performs another action, refer to later section on step scripts.

Initial diagnostics (SELF TEST)

As soon as the unit is powered on, it checks itself.

```
Self Test...  
CFTFU-X16    V 1
```

The main display shows the *SELF TEST* state indication, the model and the firmware version.

During this time check that the beeper is sounding, the green safety indication is illuminated, and the LCD backlight is turned on.

If testing succeeds the welcome screen is displayed:

```
Trinity Digital  
CFTFU-X16    V 1
```

If testing fails the unit will not operate and the fault will be shown.

```
Self test failed  
  
Supply too low
```

Various tests are performed, summarised here:

Test	Purpose
Supply test	The supply voltage should not be lower than 12 volts.
Key pad	Buttons should not be stuck.
Disarmed	The unit is in a disarmed state and no voltage is seen on the cue terminals.
Cues	The cue firing switches are all off.
Trigger	The trigger signal is not stuck.
Radio	The radio system is operational and ready.
LCD	LCD and backlight is operational.
Beeper	Safety sounder is operational.
Green lamp	Green safety indicator is operational.
Calibration	Calibration is good.
Configuration	Configuration and other settings are all good.
State & Circuitry	The internal operating state and other electronics are good.

Main display

The main display shows system state.

If you are unsure as to the display you are viewing, repeatedly press the  button or hold it down for 2 seconds returns you to this main display.

```
U001 F001  V18.3  
  
DISARMED
```

U shows the unique unit address in your show setup and is from 1 to 256.

F is the firing address and again is from 1 to 256. Many units may have the same firing address, in which case they will fire at the same time when controlled by a remote master.

V shows the supply voltage.

The second line shows the condition of the unit.

Menu system navigation

The menu system provides access to settings and operating state of the unit.

It is a multi-level menu system.

It consists of an LCD display that has two lines, each with 16 characters.

It also has four buttons:

 - Enter menu system; exit a menu sub level; abandon a change being made.

 - Enter a menu sub level; change a setting; or save the change being made.

 &  - Scroll through menu options or change a setting.

From the main display you press  to enter the menu system.

Once in the menu system pressing  will 'back out' of whatever sub level you are in, ultimately re-treating back to the main display. Holding  for 2 or more seconds will immediately cancel your current operation and return to the main display.

Inactivity of 90 seconds will cancel the current operation and return you to the main display.

Menu summary

Sub level	Purpose
Main display + Addressing + Addressing mode + Unit address + Firing address + Join network? + Cue testing + Do cue test? + 123456789¹⁰¹¹¹²¹³¹⁴¹⁵¹⁶ + <CUE RESULTS – SEE LATER> + Battery testing + Do load test? + Peak amps + Battery result + Battery type + Remote arm lock + Arming lock + Local arming + Arm system + Arm system? + Firing pulse + Set pulse time + Trigger debounce + Set debounce + Step programme + <SET> to erase + Step programme + <SET> to default + <SCRIPT ENTRIES – SEE LATER> + Logging + Logging state + Set Logging + Adaptive firing + Adaptive state + Set adaptive + Discreet mode + Discreet mode + Set discreet	Main display - Configure remote master addressing - Unit & firing address or Unit only (FA tracks UA) - Unit address - Firing address - Connect to a radio master - Test cues - Perform a cue test - Test result summary - Cue result detail for each of 16 cues - Battery testing - Test battery performance - Display battery Amps capability - Show battery test result - Set the type of battery used - Allow remote master to arm unit - Display and set current lock state - Arm unit for trigger firing / stepper script - Arm the unit - Confirm arm unit - Display firing pulse - Change firing pulse - Trigger debounce / sensitivity - Change trigger debounce / sensitivity - Step programme during trigger operation - Erase step programme - Step programme during trigger operation - Create a simple default step script 32 Script entries, refer later in document - Log functions - Log enable/disable state - Change logging state - Adaptive firing operation - Display adaptive firing state - Change the adaptive firing state - Turn on/off green safety indicator and bleeper - Displays discreet mode state - Change discreet mode state

Addressing the unit

You only need to set the addresses if you are intending to control the unit by radio.

The unit has two addresses.



A unit address (UA) uniquely identifies this unit to the remote master, each unit must have a unique UA, if more than one unit shares the same UA you will have communications difficulties.

The UA also allows you to identify a unit when performing diagnostics, this is especially useful when you have duplicate firing addresses and one or more have an issue.

The second address known as the firing address (FA) is used to send firing commands. It does not have to be unique.

When more than one unit has the same FA they will fire together. It is a quick way to duplicate firing actions.

Setting the unit and/or firing address

The UA and FA are values from 1 to 256.

From the main display, press  to activate the menu.

```
Select menu item
Addressing
```

Press  to enter the addressing menu sub level, more options are now shown.

```
Addressing mode
UA and FA
```

Use  &  to cycle through the options until you see “Unit address” (or “Firing address” as necessary).

```
Unit address
UA: 001
```

```
Firing address
FA: 001
```

Press  to change the Unit address in this example.

```
Set Unit address
UA: 001
```

Use  &  to cycle through the addresses.

```
Set Unit address
UA: 032
```

Press  to set the Unit address selected.

Press  to exit this sub menu.

Continue to press  to exit the sub levels until you return to the main display. Alternatively hold the menu button down for two seconds to exit the menu system and return to the main display immediately.

The main display will now show:

U032 F001 V18.3
DISARMED

Changing the addressing mode

When controlled by a remote master the unit has a UA and an FA address as described.

For simplicity it is possible to have the FA follow the UA automatically.

This is called “Unit only” mode. Whatever the UA is set to, the FA will match and there is no need for you to configure it.

This is ideal if all of your FA’s will be unique anyway, as it cuts down address configuration effort.

From the main display, press  to activate the menu.

Select menu item
Addressing

Press  to enter the addressing menu sub level, more options are now shown.

Addressing mode
UA and FA

Press  to change the mode.

Set addr mode
Unit only

Use  &  to cycle through the modes.

Press  to set the mode selected.

Press  to exit this sub menu.

Joining a remote master

The radio communication is secured.

The unit must join a remote master to share its security key and respond to its commands.

Once joined to a remote master the unit will remember this even after being turned off.

You only need to perform a Join operation when the master changes its security key or you need to join a new master that has a different security key.

From the main display, press  to activate the menu, use  &  to select the Addressing menu.

```
Select menu item
Addressing
```

Press  to enter Addressing sub level.

Now use  &  to show "Join master?".

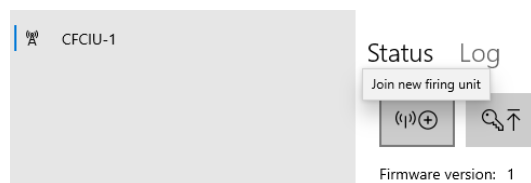
```
Join master?
<SET> to begin
```

And press  to select it and begin a Join operation

This screen is now shown:

```
JOIN IN PROGRESS
Any key to stop.
```

Using the CATFire PC software go to the CFCIU-1 interface unit settings and click "Join a new firing unit" button:



The join operation will begin and take a few seconds to complete, observe the CATFire PC software for result of the join operation.

Cue testing



CUE TESTING IS A DANGEROUS OPERATION – PYROTECHNICS COULD IGNITE
Personnel should retreat to a safe location during any testing of pyrotechnics.



When testing cues that have devices other than igniters attached, e.g. relays or
motors, those devices could inadvertently activate and cause harm.

From the main display, press  to activate the menu, use  &  find Cue testing menu sub level.

```
Select menu item
Cue testing
```

Press  to enter Cue testing menu sub level, the following screen is shown:

```
Do cue test?
<SET> to begin
```

Press  to begin a test, the following screen is shown during testing, which takes a few seconds:

```
TESTING CUES
TESTING CUES
```

During testing a small electrical current is passed through each cue and the resistance is monitored.

Also, the switches are checked for correctness too, even if there is nothing connected to a cue terminal, correct switch operation is tested.

After completion of the test you will briefly see the following screen as the circuits are drained of energy and is completely normal:

```
U001 F001 V18.3
< NOT DISARMED >
```

The following screen will show and you can press  &  to view detailed result screens.

```
12345678910111213141516
0000      !      0 0
```

Press the  to back out of testing sub level when you are done.

Understanding test results

Summary

A summary screen looks as follows:

```
12345678910111213141516
0000      !      0 0
```

Indicator	Meaning
O	Cue tests OK, both the firing electronics and the resistance observed are good.
<BLANK>	Firing electronics are good but the resistance is bad – there appears nothing connected that can be fired.
! (Exclamation)	Firing switch electronics appears faulty.

Detailed information

Further presses of  &  scroll through detailed information for each cue.

```
Results for 12
Ohms: 2.6      OK
```

Status code	Equivalent summary indicator	Meaning
OK	O	Cue checks out ok.
LOW	<BLANK>	Resistance appears abnormally low.
HIGH	<BLANK>	Resistance appears abnormally high; The firing system would not be able to deliver at least 1 ampere of current given the supply voltage and apparent resistance.
SON	!	 Firing electronic switch appears stuck in the ON position. When armed this could cause a system short circuit and immediately fire any pyrotechnics attached to it. NOTE: In salty conditions the enclosure surface can become more conductive, the sensitive test circuit can register one or more cues as being stuck on. Wash the unit with clean water and retest. IF THIS PROBLEM PERSISTS DO NOT USE THIS UNIT CONTACT TRINITY DIGITAL FOR ADVICE
SOFF	!	 Firing electronic switch appears stuck in the OFF position. DO NOT USE THIS CUE CONTACT TRINITY DIGITAL FOR ADVICE

Arming and disarming the unit

Remote firing computer arming



When a remote firing computer is connected to the unit using radio, it is possible for a remote operator to arm and fire.

The remote operator may be unaware of your presence and could put you in danger.

You must unlock the ability for a remote firing computer to arm and fire.

This feature prevents a remote operator, who may be unaware of your presence, from arming and firing.

To unlock the unit for remote arming and firing:

Enter the menu with , and use  &  to find the “Remote arm lock” screen and enter the sub level with :

```
Select menu item
Remote arm lock
```

The sub level screen is shown:

```
Arming lock:
LOCKED
```

To make a change press  and the screen becomes:

```
Set Arm lock:
LOCKED
```

Use  &  to change it, and set the selection with , described in the following table:

Arming lock state	Meaning
LOCKED	Remote firing computer cannot arm and fire
UNLOCKED – TEMP	Remote firing computer is allowed to arm and fire. This state is lost when the unit is switched off and will be LOCKED on next power on.
UNLOCKED - PERM	Remote firing computer is allowed to arm and fire.  This state is remembered even after being powered off. The unit will be UNLOCKED when switched back on.

When unlocked the main display shows:



U032 F001 V18.3

ARM UNLOCKED

This display is showing you that the unit is not armed, but is unlocked for remote arming.

Permanent unlocking (UNLOCKED – PERM)

By selecting UNLOCKED – PERM (see above selections) the unit will always permit a remote firing computer to arm and fire the unit.

This is a potentially dangerous option to choose where operators may be unfamiliar with the unit and the circumstances.

It is, however, useful in scenarios where the unit may be inaccessible - and switched on just before a show using an external power source, perhaps.

If the unit is switched on while the master is sending arm commands the unit will immediately arm and possibly fire.

Armed indication

When the unit is armed – either locally or remotely, the main display changes as follows:

SYSTEM ARMED

Any key DISARMS

The safety green indicator and bleeper fall silent.



REMEMBER REMEMBER: Don't see the green indicator and hear the beep?

APPROACH WITH CAUTION!

Disarming

Various scenarios will cause the unit to disarm.

If the unit is being controlled by a remote firing computer it can disarm the unit.

You can press any key on the keypad to immediately disarm the unit – even when controlled by a remote firing computer and during a show, if you need to.

Furthermore, where a remote firing computer has armed the unit, the trigger input can be used to disarm the unit too, this permits you to set up a wired disarm of the unit from a distance.

When you disarm the unit where a remote firing computer armed it, the unit will return to the ARM LOCKED state – preventing the firing computer from re-arming.

You can manually unlock arming once more even during a show, if the master is still sending arm commands the unit will immediately arm and begin firing.

IMPORTANT: If the unit was in the UNLOCKED – PERM state and you turn the unit off, then on again, it will accept arm commands and begin firing immediately. When powered off any automatic script commands will be lost, manual firing from the firing computer is still possible.

Local arming

The unit can be armed using the menu, this is called ‘local’ arming.

When a unit is locally armed, firing occurs using the trigger input terminals.

Firing occurs to a built-in script, on each trigger input the next step of the script is executed.

Any press of the keypad buttons will disarm the unit.

Enter the menu with , and use  &  to find the “Local arming” screen and enter the sub level with .

```
Select menu item  
Local arming
```

The sub level screen is shown:

```
ARM System  
<SET> to ARM
```

Press  to set arming and the screen becomes:

```
ARM System?  
NO
```

Use  &  to change it to YES, and set the selection with , the unit is now locally armed.

Press the  to back out of testing sub level when you are done.

The main display now shows:

```
SYSTEM ARMED  
Any key DISARMS
```

Trigger input

The trigger input terminals are voltage free terminals – they require you to supply a current through them to register a ‘trigger’.

The trigger is not polarity sensitive (+ or – don’t matter here) but it must be a DC current source to operate successfully.

It requires at least 500 milliamps, preferably 1 amp, to register a trigger input has occurred.

The trigger input is designed to act rather like an igniter, albeit with a larger ohm reading (12 ohms).

The trigger can take up to 60 volts.

Wiring up a trigger input

You can connect triggers in series or parallel, but be sure to observe the higher resistance when connecting in series, or the higher current requirement when connecting in parallel.

For example, two triggers connected in series, is 24 ohms. This will require 24 volts to cause 1 amp of current to flow.

With two triggers in parallel, 12 volts is sufficient, but the trigger source will need to provide 2 amps.

Trigger source

The source of a trigger can be as simple as the two wires being tapped across the terminals of a 9v battery or using the CFTU-0124 unit.

Or perhaps a battery box with push button to activate the current through the trigger.

A more sophisticated way to connect the trigger is to the cue terminals of another firing unit.

In this scenario it is possible for one firing unit to command a sequence of actions of another, or complex daisy chained actions, with units triggering other units into action.

Testing the trigger

The nominal resistance of the trigger is about 12 ohms.

To test that the wiring connections are good, 50 milliamps or LESS current should be applied.

Testing can be performed even when the unit is powered off.

Do not supply any more than 50 milliamps as a test current or inadvertent triggering may occur.



TESTING IS A DANGEROUS OPERATION – PYROTECHNICS COULD IGNITE
Make sure the unit is powered OFF during testing.

Trigger debounce (sensitivity)

Whenever a button is pressed, or wires are tapped across a battery - so as to cause a trigger input - the connection is not a clean one and can in fact make the unit think there are several trigger inputs occurring in quick succession.

This could action many steps in your script – ruining your show because several steps will overlap.

Before the electrical contact ‘settles’ into an on or off state, this noise is called ‘bounce’, and the unit must ignore this – looking only at the signal when settled in its on or off state.

It is an amount of noisy time.

The setting ranges from 10 milliseconds to 255 milliseconds.



The default setting is 50ms which is fine for most cases, but you must test this out before your show, preferably using lamps connected to the cue terminals so that you can see whether the unit debounce is set correctly.

Some firing units have a pulse time which is much less than 50 milliseconds, e.g. 20 milliseconds. When connecting the trigger to a cue terminal of another firing unit be sure to set the debounce time to slightly less than the pulse time of that unit and test it out several times to be sure it is registering the trigger correctly.

IMPORTANT: You do not set the debounce time to the pulse time, you need to set it to clear the period of so-called noisy time.

Change the trigger debounce time as follows.

Enter the menu with , and use  &  to find the “Local arming” screen and enter the sub level with :

```
Select menu item
Local arming
```

The sub level screen is shown:

```
ARM System:
<SET> to ARM
```

Use  &  to select the sub level.

```
Trigger debounce
050ms
```

And press  to change the value, the screen changes to:

```
Set debounce:
050ms
```

Use  &  to change it, and set the change with .

Press the  to back out of testing sub level when you are done.

Firing pulse time

NOTE: The firing pulse time only applies when the unit is locally armed, when controlled from a firing computer the firing pulse time is decided by that.

When a cue is fired, the electronic switch is turned on for an amount of time – a pulse of energy is sent through the igniter to light the pyrotechnic device attached to it.



The default pulse time is 2000 milliseconds, two seconds.

This is a long amount of time but it will fire electric matches and Talon® style igniters too.

Usually there is no need to change this.

When firing electric matches, however, this is a potential waste of battery energy as a pyrotechnic electric match will fire very quickly indeed, e.g. 50 milliseconds is more than enough.

The pulse time can be set from 10 milliseconds to 65530 milliseconds.

When changing the pulse time it is important that you test it with real igniters to ensure they fire reliably every time.

When using adaptive firing feature of the unit you may want to more accurately reflect the pulse time needed by the igniter, as this will give better timing precision when adaptive firing is needed.

Enter the menu with , and use  &  to find the “Local arming” screen and enter the sub level with :

```
Select menu item
Local arming
```

The sub level screen is shown:

```
ARM System:
<SET> to ARM
```

Use  &  to select the sub level.

```
Firing pulse
02000ms
```

And press  to change the value, the screen changes to:

```
Set pulse time:
02000ms
```

Use  &  to change it, and set the change with .

Press the  to back out of testing sub level when you are done.

Adaptive firing

Adaptive firing aims to give more reliable firing.

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Like other firing systems, this unit will fire when told to do so. When adaptive firing is active it can adjust the firing timing to ensure the battery is not overloaded, thereby increasing firing reliability.

When the battery is in a sub optimal condition, heavy firing can cause the battery to ‘flag’ – like car headlights dimming when you crank the engine.

This can cause unreliable firing in extreme conditions.

This is usually the case with poor quality or old batteries or in extremely heavy loads / firing patterns.

NOTE: Remember with this unit you can also add additional pairs of batteries to increase available firing current or use an external power source.

So what does adaptive firing do?

Adaptive firing will change the timing to avoid excessive battery load, thereby ensuring that cues get the energy they need.

Once the peak amps a battery can deliver is known – through a load test - it can determine the optimal firing timing.

Under most scenarios adaptive firing takes no action, however, given 1 ampere per cue, if more cues are fired than the battery can deliver, some cues will be delayed until others have finished firing.

This ensures the battery will not be under more load than it can deliver and so fire more reliably.

Adaptive firing is turned on by default but will only function when a battery load test has been performed since being switched on.

To enable or disable adaptive firing, enter the menu with , and use  &  to find the “Adaptive firing” screen and enter the sub level with :

```
Select menu item
Adaptive firing
```

The sub level screen is shown:

```
Adaptive state:
Disabled
```

Press  to change, the display changes:

```
Set adaptive:
Disabled
```

Use  &  to change and press  to change the value, the screen changes to:

```
Adaptive state:  
Enabled
```

Press the  to back out of testing sub level when you are done.

Battery type selection

The unit defaults to expecting 9v PP3 type batteries to be installed.

When using SLA (Sealed Lead Acid) batteries to power the unit using the external battery terminals you need to change the mode to 12 or 24 Volt SLA.

Enter the menu with , and use  &  to find “Battery testing” and enter the sub level with .

```
Select menu item  
Battery testing
```

The sub level screen is shown:

```
Do load test?  
<SET> to begin
```

Now use  &  to find “Battery type”

```
Battery type:  
18V PP3
```

Press  to change the battery type, the display changes to:

```
Set batt type:  
18V PP3
```

Now use  &  to select the battery type you want and press  to set the new type.

Press the  to back out of the sub level when you are done.

Load testing the battery

The load test feature finds out the number of amps the battery can deliver.

This is a far more reliable way to determine if a battery is in good condition, most other firing systems only determine the battery voltage - which can recover after a period of non-use - and appear good, but then flag dramatically during firing – causing disaster for your show.

Never assume brand new batteries will function well either, manufacturing defects can cause batteries to falter under load.

When running load tests on a unit you should do this at a time when it will be convenient to change batteries as may be needed.

If a load test indicates a poor result even after trying new batteries a few times, try using those batteries on another unit to compare against. It could be the wiring or connections leading from the battery that are at fault – including the wiring loom connecting the power board to the control board of the CFTFU-X16.

Once the load test is performed, this information is used by Adaptive firing and the battery test to identify the condition of your battery.

The load testing is only performed when you want to, if performed too many times, will weaken the battery.

To perform a load test:

Enter the menu with , and use  &  to find “Battery testing” and enter the sub level with :

```
Select menu item
Battery testing
```

The sub level screen is shown:

```
Do load test?
<SET> to begin
```

Press  to perform a load test, the screen changes as follows:

```
TESTING BATTERY
TESTING BATTERY
```

Once complete the previous display will reappear.

Use  &  to scroll through the sub level screens to show the results of load testing and battery testing.

```
Peak amps:
18A
```

```
Battery result:
EXCELLENT
```

NOTE: You do not have to run a load test in order to analyse the battery. You can go straight to the “Battery result” screen above at any time. The unit will use only the battery voltage to report on its condition in this case. Once a load test is performed the battery test results will incorporate the latest load test result into its calculation.

Press the  to back out of testing sub level when you are done.

NOTE: If you want to use adaptive firing you must perform a load test at least once after powering up the unit and before arming the unit.

The maximum amps the unit will display is 80A.

Brownout

When the battery is in a very weak state running a load test can cause the battery to falter such that the unit will reset itself (also known as “brownout”) – it will be obvious that the unit has done this as it will go back through its self-test sequence.

If this happens change the batteries immediately. Adaptive firing will not help in this instance.

Discreet mode

The unit contains a green safety indicator and a heartbeat bleeper.

When the unit is in a disarmed state the heartbeat bleeper will bleep briefly every three seconds and the green safety indicator will flash.



Rule of thumb: When you do not hear the bleep or see the green lamp
APPROACH WITH CAUTION.

This can be inappropriate for some situations where the unit must remain silent and not be seen, for example stage/theatre productions.

These indicators also consume power so turning them off will increase run time.



IN DISCREET MODE YOU MUST ALWAYS APPROACH WITH CAUTION BECAUSE
THE OPERATING CONDITION OF THE UNIT WILL NOT BE KNOWN.

Enter the menu with , and use  &  to find “Discreet mode” and enter the sub level with .

```
Select menu item
Discreet mode
```

The sub level screen is shown:

```
Discreet mode:
Disabled
```


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Press  to change, use  &  to enable discreet mode and press  to set the change:

```
Set discreet:
Enabled
```

Press the  to back out of the sub level when you are done.

Logging

The unit contains a log of its operation. It remembers the log entries created even after power off.

It can store hundreds of log entries, once out of space it will overwrite older log entries though these can be backed up using the CATFire™ PC software so you don't lose any.

This log is readable from the remote master over the radio.

It is useful as a diagnostic aid for both operators and Trinity Digital.

If, during your show, something does not go to plan, reading the log can help with diagnosing why the unit did what it did, or not as the case may be.

Logging consumes power, however, and if you do not intend to use logging it can be disabled.

Enter the menu with , and use  &  to find "Logging" and enter the sub level with .

```
Select menu item
Logging
```

The sub level screen is shown:

```
Logging state:
Enabled
```

Press  to change, use  &  to change it and press  once more to set the change:

```
Set logging:
Disabled
```

Press the  to back out of testing sub level when you are done.

Scripts

NOTE: When using a remote firing computer, refer to the CATFire PC software for advanced pyromusical script designing.

This section is concerned with local trigger controlled scripting also known as a "stepper script".

The unit contains a script that you can configure.

The script is used when the unit is locally armed and fired using the trigger input.

The script contains up to 32 entries.

Each entry can turn any of the cues on, off or fire (pulsed on/off). It can also action each cue of an entry in a timed manner, so chase sequences can be implemented very easily.

Once an entry has been processed the unit can wait for the next trigger input – or – automatically execute the next script entry after a period of time.

Any script entries that cause no action, e.g. no cues are affected, are skipped automatically. This permits entries to be left blank for later completion.

Default script

The unit contains a default script.

Activating it will overwrite any script you have created.

The script is very simple: On each trigger input the next cue will fire, starting from cue 1.

Enter the menu with , and use  &  to find “Local arming” and enter the sub level with .

```
Select menu item  
Local arming
```

The sub level screen is shown:

```
ARM System?  
<SET> to ARM
```

Use  &  to select the following screen:

```
Step programme:  
<SET> to default
```

Press  to erase any existing script and create the default one.

Press the  to back out of the sub level when you are done.

Erasing the script

Enter the menu with , and use  &  to find “Local arming” and enter the sub level with .

```
Select menu item  
Local arming
```

The sub level screen is shown:

```
ARM System?
<SET> to ARM
```

Use  &  to select the following screen:

```
Step programme:
<SET> to erase
```

Press  to erase the script.

Press the  to back out of the sub level when you are done.

Editing the script

The script has 32 entries and can be accessed from the “Local arming” menu sub level.

Entries look like one of the following:

```
00 UNUSED
```

```
F 000000 MANUAL
#
```

An UNUSED entry shows the entry number, during firing an unused entry is ignored.

An entry that has been configured is shown on the right.

Here, F shows to indicate Fire (Pulsed on/off), other actions are:

Action code	Action
F	Fire, pulse cue on/off according to the configured pulse time
1	Turn on cue
0	Turn off cue

The next six digits are the interval in milliseconds.

When 0 all cues marked as # on the second line will be actioned immediately this entry is triggered.

When greater than 0, each cue, starting with the lowest numbered cue, will be actioned after this interval. It is a quick way to set up a chase sequence.

MANUAL, here, indicates that once this entry is processed, the script programme will wait for the next trigger input before executing the next script entry.

It can also be a number, in which case it is in milliseconds and the next script entry will be executed after this many milliseconds. It should be noted that this is an amount of time from when this current entry starts executing, not when this entry has completed its actions.

The second line shows each cue affected by this entry.

The leftmost is cue 1, the rightmost cue 16. A hash (#) shows that the cue is selected for this sequence.

Rapid firing

Entries will be processed on each trigger input.

You do not have to wait for one entry to fully complete its action before causing another trigger input.

Rapid trigger inputs will process each subsequent entry – causing entries to overlap – and rapid firing occurring.

This can also be useful if the pyrotechnics end sooner than expected and you need to issue another trigger to pick up the pace.

Any entries that have auto advance timer set on them will be cancelled and actioned immediately on a trigger input, this allows you to override such automatic advancement if you need to.

Editing a script entry

Display the script entry you want to edit and press .

The display changes to:

```
01 Action:
FIRE (F)
```

Use  &  to move through the entry settings.

To edit the entries Action function, press  and use  &  to change the action then set the change with .

Action code	Action
F	Fire, pulse cue on/off according to the configured firing pulse time
1	Turn on cue
0	Turn off cue

```
01 Set Action:
FIRE (F)
```

Interval is the time delay between each cue selected for the entry, the time is in milliseconds:

```
01 Interval:
000100ms
```

Auto advance is the time in milliseconds from when the entry is processed until it will automatically execute the next entry and does not wait for a trigger input.

01 Auto advance:
Trigger required

It can also be “trigger required” in which case the script will pause, waiting for the next trigger input to continue with the next entry.

Selecting the cues, this entry affects, are chosen with this screen:

123456789₁⁰₁¹₁²₁³₁⁴₁⁵₁⁶

The hash (#) shows which cues are affected.

When editing the screen changes to:

 ^

The cursor (^) is the cue you are changing, cue 1 is left most, pressing  toggles selection (#). Use  &  to move the cursor.

Press  will complete the selecting of cues.

When no cues are selected this entry will show as UNUSED.

Safety groups

Safety groups are a way to enable and disable firing according to conditions during your show.

Safety groups are only used when fired using a remote firing computer and the CATFire firing software.

CATFire supports 32 safety groups for types of material and 32 position related safety groups, 64 groups in total.

Each group is given a meaningful name such as “Rockets” or “Rooftop”.

Pyrotechnic material is assigned to one or more material-related safety groups.

Positions are assigned to one or more position-related safety groups.

A cue is associated with a material at a position and so gets the combinations of these groups.

During firing a cue may fire only if all safety groups assigned to it are enabled.

Coarse and fine grained control over firing is possible with safety groups.

For example, shells are associated with the “All Shells” safety group.

This group must be enabled for any shells to fire. Should wind conditions during the show become high risk, “All Shells” can simply be disabled to stop firing any more.

Another example might be “Rockets position 1”. Should the rocket position become damaged, it is possible to stop any further firing from that position simply by disabling the group.

Refer to the CFWFS-1 (Windows Firing Studio) user manual for more information on safety groups and their use.

End of life

Recycling

Sadly, this product will not last forever, wear and tear will eventually bring about its end of life.

This product contains precious earth metals and other recyclable material.

You should dispose of the product in accordance with your local authority rules on recycling electronic devices – please do not dispose of this product in general waste.

Alternatively, you may return your end-of-life equipment to Trinity Digital for correct recycling. Please contact support@trinitydigital.co.uk or call +44(0)1782 977500 to do so before returning equipment so that we may track its recycling properly.





Guarantee

The Guarantee is provided by Trinity Digital, the owner of the CATFire® brand.

Terms and conditions

These terms and conditions do not affect your statutory rights.

You must register your product within 14 days of purchase to receive this guarantee, please contact support@trinitydigital.co.uk or call +44(0)1782 977500 to do so.

Have your product model and serial number to hand including the date and place of purchase. If the product is a gift, register the intended owner details.

This product carries a 12-month parts and labour guarantee against defects in workmanship.

These terms and conditions are only applicable within the United Kingdom and is subject to provision(s) that your product:

1. Has been used solely in accordance with the instruction manual.
2. Has not been subject to misuse or accident; modified or repaired by anyone other than our own service engineers.
3. The product is in the United Kingdom.
4. The product has been registered and the person claiming is the registered owner.

If you wish to make a claim contact support@trinitydigital.co.uk or call +44(0)1782 977500.

Please provide the model number, the serial number, and a description of the fault. When emailing you can also provide images or video footage of the issue you are experiencing.

Trinity Digital will, at its discretion, repair or replace the unit.

Please do not send anything to Trinity Digital without first contacting us, nothing can be accepted without prior authorisation, this is so we can track the product and its problems properly.

Declaration of conformity

- UKCA: Electrical Equipment (Safety) Regulations 2016
- UKCA: Radio Equipment Regulations 2017
- 2014/30/EU Electromagnetic Compatibility
- 2014/53/EC Radio Equipment Directive
- 2011/65/EU RoHS
- 2012/19/EU WEEE

Trinity Digital hereby certifies that the product

CATFire CFTFU-X16

Conforms to the essential requirements of the above listed regulations and directives on this day Friday 1st January 2021.



Mr. Gareth Williams.

Company:

Trinity Digital
Unit 14A
Spring Bank Farm
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NOTES