Transolve MF-20 (Multi-Fire 20) Launch Control System

Overview

The MF-20 launch control system was designed and built in 2003 by John Fleischer of Transolve Corporation (www.transolve.com). The system is configured to manage and fire up to 20 rocket firing channels, either individually, or in groups. Each channel has its own 12V/15A ignition relay which is capable of switching a high current level through an igniter, ensuring a positive ignition event. Each channel also includes high brightness LEDs at both the Firing Boxes and at the LCO Console to indicate igniter continuity. The continuity indications are active whether the LCO Console is Safed or Armed.

The system consists of three aluminum cases and some connecting cables. The cases are the LCO control box or Console, a remote Firing Box that is to be located at the Model Power Rocketry (MPR) range, and a second remote Firing Box to be located at the High Power Rocketry (HPR) range. Each Firing Box supports up to ten (10) pads and requires its own local 12V ignition battery. The LCO Console operates off of two 9V batteries.

Each control box has been housed in a durable, finished plywood cabinet. The cabinets serve to protect the aluminum cases thus making the system more robust for handling and transport.

The system is stored and transported in two convenient and manageable tote boxes:

Photo 1: Transolve MF-20 Storage

Box 1 contains the three system control boxes and the connecting cable for the model rocket range, as shown in Photo 2:

Photo 2: Box 1

Box 2 contains the much longer (~150') connecting cable for the HPR range as well as a set of 10 igniter leads:

Photo 3: Box 2

LCO Console

The LCO Console has a latched, but removable, top cover; Photo 4 shows the Console with the top cover removed:

Photo 4: LCO Console

Starting with the master controls along the bottom of the console there is the Launch Button on the right, to its left the Arming Key Switch, a toggle switch to check continuity (more on this in a moment), the range selection switch (either Model Power Rocketry (MPR) or High Power Rocketry (HPR); only one of the ranges can be operated at any time), and a voltmeter. The voltmeter presents the ignition battery level at the remote firing boxes; it shows the model rocket ignition battery level when the range selector is in the "MR" position, and it shows the HPR ignition battery level when that Firing Box is connected and the selector switch is in the "HPR" position.

Operation requires at least one of the Firing Boxes to be connected, as the igniter control relays are located within the Firing Boxes. It is not possible to fire igniters directly from the LCO Console. Note that it is not required to have both Firing Boxes connected for the system to be operational; minimum operation requires just one Firing Box to be connected.

Photo 4 also shows two banks of pad select switches. There is one bank for the model Rocket range and a second bank for the HPR range. The bank switches are pad select switches, so when a switch is flipped into the "UP" position the associated pad becomes active. Above each switch is a high brightness LED; this LED shows continuity for the associated pad (assuming the igniter is good and connected properly), and this status is independent of the LCO Console Arming Key Switch. That is to say, the LCO Console can be Safed with the key switch removed, and the LEDs will still show continuity if a rocket is properly hooked up at the pad.

NOTE: **Continuity will not show at the LCO Console unless the Continuity toggle switch is in the UP position.** This switch allows the LCO to turn the indication off after checking to conserve local 9 Volt battery power.

The firing circuit is controlled by the LCO Console and is powered by two internal 9 volt batteries. To replace these, the left side of the LCO Console must be opened.

Photo 5: LCO Console – Internal Battery Access

The aluminum electronics case must then be removed, and the case top sprung open:

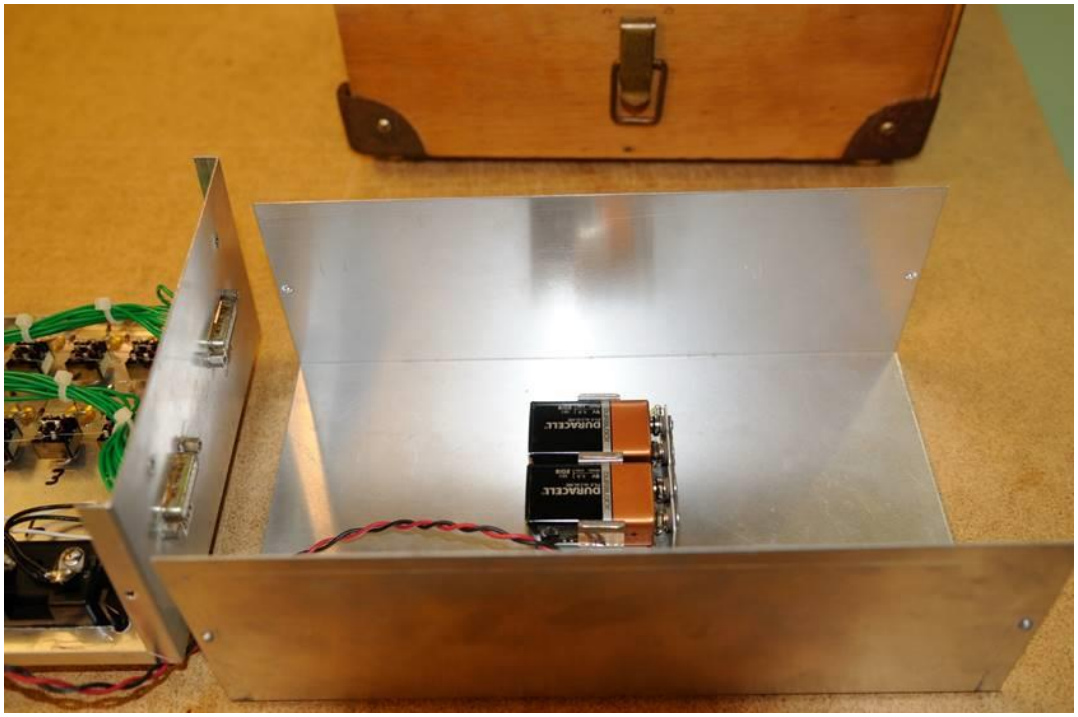

Photo 6: LCO Console Internal Batteries

A set of LCO Console batteries should last about one launch season, so these should be replaced annually, or when it appears the LCO Console is unable to operate an ignition relay in either of the Firing Boxes.

Firing Box

The system includes two Firing Boxes; one for Model Power Rocketry (MPR) operation, and one for High Power Rocketry (HPR) operation. It should be noted though that the two boxes are functionally and electrically identical, and can be swapped for each other if needs be.

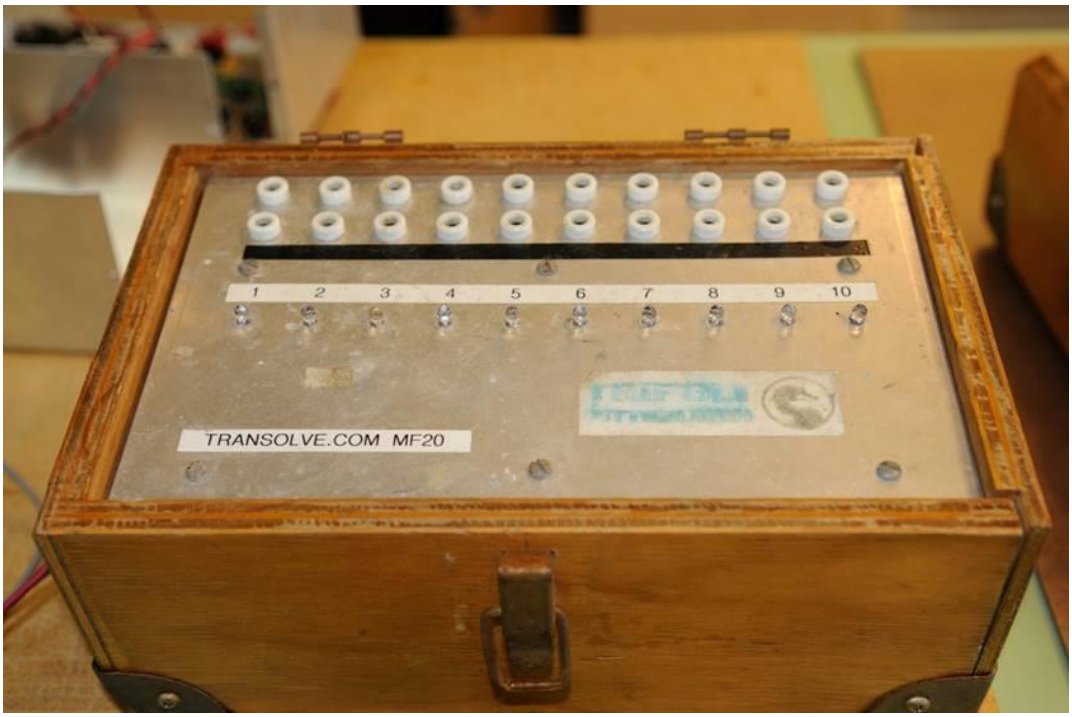

Photo 7: MPR Firing Box

Each Firing Box comes with an integral set of ignition battery leads/clamps. Each Firing Box must be connected to, operated from, its own external 12V battery for the firing circuits to work. Igniter leads are connected to the system by way of the bank of banana plug sockets located along the top. High brightness LEDs automatically display continuity status once the igniter leads are hooked up to an igniter.

There is a switch located on the side of the box that is used to ARM/SAFE the Firing Box, as shown in Photo 8:

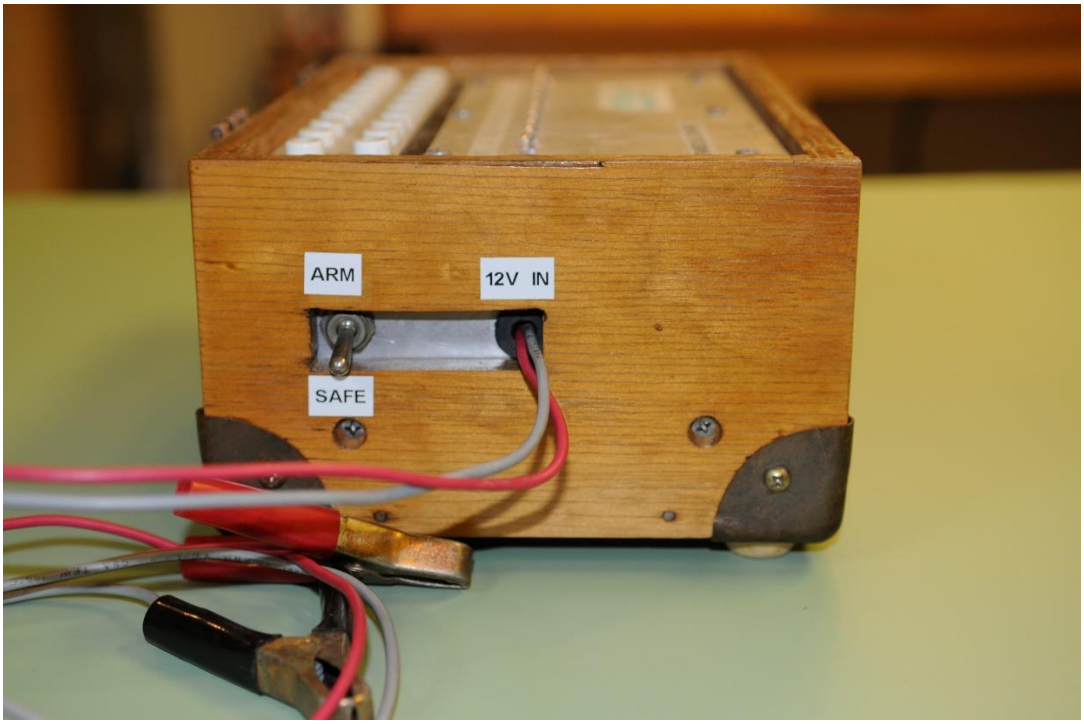

Photo 8: Firing Box ARM/SAFE Switch

The ARM/SAFE switch is a redundant safety feature that allows a Flier to locally disconnect the ignition battery from the Firing Box while setting up a rocket on the pad. With the switch in the SAFE positon it is not possible to fire an igniter, regardless of the position of Master Key Switch back at the LCO Console.

When in SAFE mode Continuity will be indicated automatically and locally on the Firing Box for the rocket igniter(s) that have been hooked up. Continuity will also be indicated for the corresponding pads back at the LCO Console, even with the Master Key Switch removed, provided the LCO Console Continuity Check Switch is in the UP position. With this system there is never a reason to have to check continuity from the LCO Console, other than to re-verify just before launch. This ensures that the LCO Console remains OFF while Fliers are present at the range.

Once the pads have been loaded, the Firing Box must be set to ARM; no igniters will fire unless the ARM/SAFE switch is placed in the ARM position. With the switch in the ARM position, Continuity will still be indicated, regardless of the position of the LCO Console Master Key Switch.

Operation

This assumes the range has been safely set up, the LCO Console and Firing Box(es) have been properly connected, and a 12 Volt battery has been connected to each Firing Box in use.

Once the Range pads have been loaded and the leads connected to each rocket, the Firing Box must be verified to be ARMed. Once the LCO has verified that the Range is safe for operation per the NAR Safety Code, the LCO will insert the Master Key Switch into the LCO Console and turn it to the ON position.

The LCO will select the Range (MPR or HPR) he/she would like to operate. The voltmeter will display the current voltage level of the ignition battery located at the selected range.

The LCO will select the pad he/she wishes to operate.

The LCO will flip the Continuity Check switch to the UP position; this will permit the continuity indicator to display its status.

Assuming that continuity is present, the Flier is ready, and the Range is still safe for operation, the LCO will call the countdown and press the Launch button. Hopefully a successful launch event takes place.

If there are more rockets on the Range ready for launch, the LCO will continue to activate the loaded pads and launch accordingly. If there are no more rockets to launch, the LCO will verify that all pads are disabled and will remove the Master Key Switch, ensuring the Range is returned to a safe state.