EXPRO
WIRELINE INTERVENTION

Combined Trigger Unit

The Combined Trigger Unit (CTU) can be used to fire any perforating gun, tubing punch, tubing cutter or setting tool on slickline without the need for radio silence.

The tool mechanism consists of three main components: Lithium Battery Pack, Electronic trigger and Surface Safety Switches.

Lithium Battery Pack

This pack comprises standard Lithium C-cells which provide firing power when the tool initiates.

Electronic Trigger

The electronics package controls the output from a battery pack. This initiates the detonator only when all safety barriers are overcome, and downhole parameters are such that they satisfy the pre-programmed firing sequence (see overleaf).

Surface Safety Switches

Individual mechanical pressure and temperature switches form short circuits across the detonator to ensure surface safety. Well pressure and temperature 'open' the switches at a pre-determined depth and 'close' them on retrieval.

Applications:	Benefits:
Deployment on Slickline of:	No E-line rig-up required
Perforating guns	Reduced personnel
Tubing punchers	Reduced cost
Tubing cutters	Easier pressure control
Bridge plugs	Radio safe

Applications for TCP:	Benefits for TCP:
Standard Tubing Conveyed Perforation Initiation	Remote and re-settable initiation
Initiation below isolated packer	Extended final time delay
	Multi-zones can be fired separately using time delay feature

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Technical SpecificationsTechnical Specification - CTU

Example Firing Sequence		Tool Ratings	
Initial delay in minutes	60	Maximum working pressure	9,000 psi (62MPa)
Temperature threshold	70°C (158°F)	Working temperature	300°F/350°F HT (149°C/176.7°C)
Pressure threshold	5,000 psi (34MPa)	Length of trigger unit (excluding explosives attachments)	47" (1.19m)
Number of control pulses	0	Top connection	15/16" (23.8mm) Sucker Rod or QLS
Stability	200psi		
Pressure pulse height	500		
Final Pressure threshold	As above		
Final delay in minutes	10		

Initial Delay
Trigger will count down the programmed number of minutes (60). Range can be 1 minute up to 22 days.

Temperature Threshold
Trigger requires 3 readings, which are taken every 4 seconds, above the programmed temperature threshold (70°C/158°F) before moving on to the next part of the firing sequence.

Pressure Threshold
Trigger requires 3 readings above programmed pressure threshold (5,000 psi) before moving on to the next part of the firing sequence.

Pressure Stability
Trigger compares previous 6 pressure readings taken every 30 seconds i.e. over a 3 minute period. If the pressure changes by more than the specified pressure stability band (200psi) then the trigger will wait another 30 seconds and again compare the last 6 readings against the programmed stability band. This process will continue until the change, over the 3 minute period, is less than the band i.e. the pressure is stable and then the firing sequence will move on to the next stage.

Control Pulse
Disabled in this example.

Final Pressure Threshold
Trigger checks that the pressure applied to it is still above the specified pressure threshold (5,000 psi). If it is, the firing sequence moves on to the next stage, but if it is not, the sequence will abort. This feature will prevent initiation of the explosives package if it gets stuck and fishing / washover operations are required.

Final Delay
The trigger will countdown the specified number of minutes (10). This feature will allow gas lift etc. if an underbalance has to be achieved for perforating. VG tool range is 1 minute to 14 days.

Technical Specification – CTU for TCP Applications

Maximum Tool Ratings	
Pressure	10,000 psi (69MPa)
Temperature	150°C (302°F)
Diameter	1.69" (42.9mm)
Length (excluding explosives attachments)	47" (1.19m)
Weight (excluding explosives attachments)	25kgs (55.12lbs) approx
Dual Mechanical Temperature Safety Switches	Selectable switch values
Electronic System Parameters	
Initial Time Safety Interlock	1 min – 22 days
Pressure Safety Interlock	150 – 10,000 psi (1MPa – 69MPa)
Temperature Safety Interlock	0-145°C (32-293°F)
Reset Requirement	Minimum Decrease of 1,000 psi (7MPa) from Pressure Safety Interlock
Final Trigger Delay	1 min – 14 days
Memory	Records 5 x Post Activation Pressure/Temperature Points and Tool Status