MilesTag
CORE
Operation Manual

Firmware Version 5.41

(RevH Main Boards)

7 Mar 2010

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READ THIS !! This is an operation manual for the MilesTag 5.41 operating system and the MilesTag CORE RevH main board. Details of tagger construction or programming are not covered in this document.

READ THIS !! Firmware for the PIC18F2525 microcontroller and sound effects (wav files) are available for free download from www.LaserTagParts.com/mtcore.htm. If you want to program the microcontroller yourself, you will need a "PIC programmer" that supports the PIC18F2525. This is a good idea as you may need the programmer to update your taggers when new firmware is released, rather than sending your PICs in for update. Firmware is updated regularly to address bug-fixes and feature updates.

We do not provide information or assistance on PIC programming. There are numerous websites, manufacturers and support forums dedicated to this. Please refer to the manufacturer of your programmer for assistance.

Preprogrammed microcontrollers, printed circuit boards and other parts are available from http://shop.LaserTagParts.com.

OVERVIEW OF SYSTEM FEATURES

- 50 Players
- 4 Teams
- Fully editable gun and game configurations
- Full-Auto Switch
- New! Support for Medic Box and Ammo Box "pick-ups".
  - Players can "pick up" additional Health and Clips on the field
- Adjustable "Barrel Overheat" function
- Automatic Respawn – Adjustable Time Delay
- Automatic Timed Games – Game Over after time limit expires
- Electronic "Flags" – Sensor LEDs flash to indicate "carry"; drop flags when killed
- Updated: "Zombie" game mode – dead players come back…. as zombies!
- Gun-to-gun wireless "Cloning" allows instant configuration of additional taggers
- Intelligent display backlight control
- Anti-cheating features
- Infrared (IR) LED fail monitor w/ alarm (RevG hardware only)
- Precision battery monitor w/ low battery warning
- Built-in Referee Gun functions (any tagger can be configured as the Ref Gun)
- Built-in ISD recorder function for uploading custom sound effects (RevH hardware only)
  - No need to purchase external sound chip programmer.

Built-In Referee Gun (Master Controller) Features:
- New Game, Admin Kill, Respawn, Pause
- Collect Scores, View Scores (individual & team), send scores to PC
- Test Sensors

Add-on Devices Supported:
- Micro MT Taggers (uMT) (uMT taggers support limited feature set / no scoring)
- Flag Station - up to 16 unique flags
- Medic Box – up to 16 medic boxes (pick-ups)
- Ammo Box – up to 16 ammo boxes (pick-ups)
- Respawn Station
- First Aid Kit (Medic)
- Ammo Can (Armorer)
- Grenade (Instant Kill or Variable Damage)
- Claymore (Instant Kill or Variable Damage)
- Bazooka (Variable Damage)
- Stun Grenade (6-second stun/flash-bang)
- Bomb / Trip Mine (Instant Kill)
- Radiation Emitter (Area Denial; Variable Damage)

RevH CORE MAIN BOARD PARTS LIST

QTY	PART # / VALUE	MFR	DESC	NOTES
1	PIC18F2525-I/P	Microchip	Microcontroller	U1 Blank chip requires firmware
1	ISD1790	Nuvoton	Chipcorder, 90 seconds, sound effects	U3 Blank requires recording
1	L4941BV	ST Micro	5V regulator, low-dropout, TO-220	U2
1	TDA7052BN	NXP Semi	BTL audio amplifier, 1W, w/ volume control	U4
1	16MHz		16MHz microprocessor crystal, HC-49U	X1
1	1N4001		Diode, Rectifier	Only on newer boards
5	IRLD110	Vishay	HEXFET, 4-pin DIP, logic-level	
1	330uF, 25V		Electrolytic capacitor, 3.5mm lead spacing	C1
1	100uF, 25V		Electrolytic capacitor, 2.5mm lead spacing	C2
1	2.2uF		Electrolytic capacitor, 2.5mm lead spacing	C10
7	.1uF, 50V		Ceramic chip capacitor, 2.5mm lead spacing	C3,C4,C7,C8,C9,C11,C12
2	22pF, 50V		Ceramic chip capacitor, 2.5mm lead spacing	C5,C6 Oscillator caps
4	10K ohm		Resistor, ¼ watt, 5%	
3	51 ohm		Resistor, ¼ watt, 5%	
1	17K ohm		Resistor, ¼ watt, 5%	
1	2K ohm		Resistor, ¼ watt, 5%	
1	4.7K ohm		Resistor, ¼ watt, 5%	
2	1.65K ohm, 1%		Resistor, ¼ watt, **1%**	Battery monitor
1	39K ohm		Resistor, ¼ watt, 5%	Volume set – 39K to 82K
1	60.4K ohm, 1%		Resistor, ¼ watt, **1%**	ISD1790 oscillator – 12KHz
1	3.3 ohm		Resistor, ¼ watt, 5%	
1	1M ohm		Resistor, ¼ watt, 5%	
			28-pin DIP IC socket, .3" width	
			28-pin DIP IC socket, .6" width	
			8-pin DIP IC socket	
2	22-23-2021	Molex	2-pin header, .1", KK friction-lock	
3	22-23-2041	Molex	4-pin header, .1", KK friction-lock	
2	22-23-2061	Molex	6-pin header, .1", KK friction-lock	
1	640445-2	Amp	2-pin header, .156", KK friction lock	
1			2x2 header, .1" pin spacing	
1			2x3 header, .1" pin spacing	
1			Insulator, mica, TO-220	L4941 insulator
1			Screw, 4-40	L4941 tab
1			Nut, 4-40	L4941 tab
1	MT-PCB-RevH	MilesTag	PC Board, MilesTag CORE (RevH)	

OTHER PARTS

| QTY	PART # / VALUE	MFR	DESC	NOTES
1	NMTC-S0802XFGHSAY-10	Microtips	LCD display module, 8 character x 2 lines	Backlight requires modification
1			LCD cable, 14C ribbon w/ 2x7 connectors	
1	EG2624	E-Switch	Switch, key-operated, SPDT	Key removable both positions
1			Button, SPST, momentary, normally open	"Display" button, BLACK
1			Button, SPST, momentary, normally open	"Reload" button, RED
1			Switch, SPST or SPDT (slide or toggle)	"Semi-Auto / Full-Auto" switch
1			Button, SPST, momentary, normally open	"Trigger" button
1	7.2V, 3200mAH		NiMH or NiCad rechargeable battery pack	2000mAh to 4000mAh
1	8 ohm, .5W		Speaker, mylar cone	
1	TSAL6100	Vishay	Infrared LED, 1.5A	Lens assembly required
1	TLCR5800	Vishay	"Muzzle Flash" LED, ultra-bright, red	
1			2.5mm x 5.5mm DC power jack	Charging jack - OPTIONAL
1			3.5mm stereo jack	Audio input - OPTIONAL
1	S22-USB-SERIAL-INT-CONN	Acroname	Serial to TTL adapter for score transfer	PC serial interface - OPTIONAL
2	CAB-2C	MilesTag	2-pin mating cable, Molex KK, .1" spacing	Cable assembly
3	CAB-4C	MilesTag	4-pin mating cable, Molex KK, .1" spacing	Mating connector
2	CAB-6C	MilesTag	6-pin mating cable, Molex KK, .1" spacing	Mating connector
1	09-50-8023	Molex	2-pin crimp terminal housing, .156", KK	Power connector
2	08-50-0106	Molex	Crimp terminal, .156"	Contact for power connector
	MISC		Lens, lens tube, wire, solder, battery charger	

PCB Parts Layout
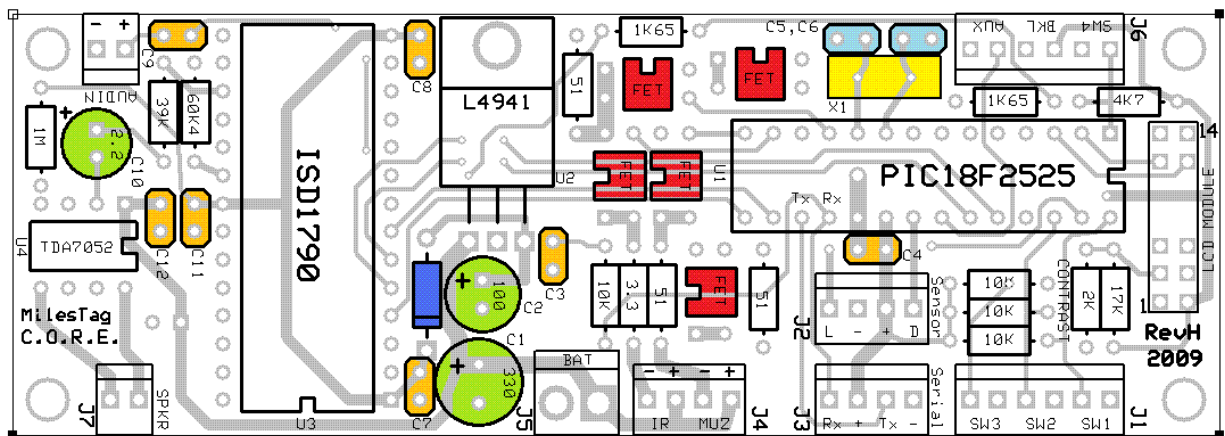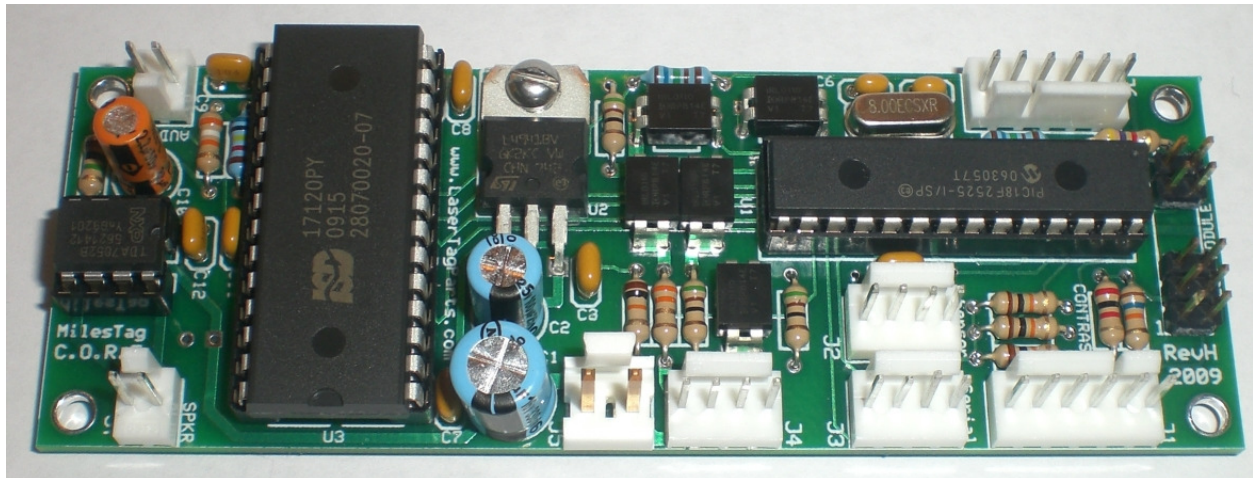
.1 uF Caps		16MHz Crystal	
IRLD110 MOSFET		22 pF Caps	
Electrolytic Caps		1N4001 Diode	

Note 1: Use a mica insulator between the L4941 regulator and the PCB.
Note 2: The 1N4001 diode is only on the newer manufacture PC boards.

Wiring Diagram
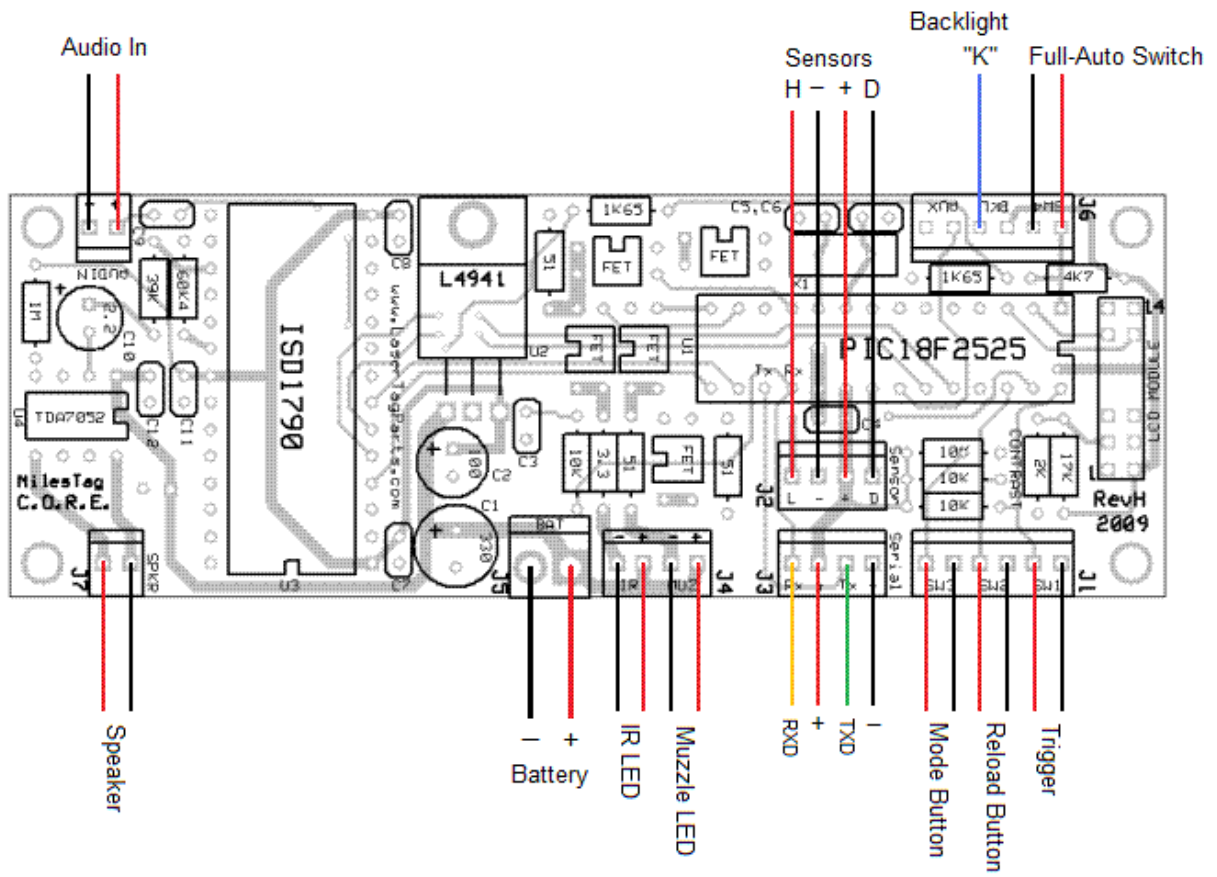
Notes on External Parts

LCD Module / Backlight

In general, the system should work with most standard 8x2 LCD character modules.

Some LCD modules may require modifications to allow the backlight to operate with the MilesTag system.

For the Microtips LCD display shown in the parts list, you must remove the jumper "R12" from the component side of the module (desolder surface mount jumper). If you purchased the LCD module from Laser Tag Parts store, then it is already modified.
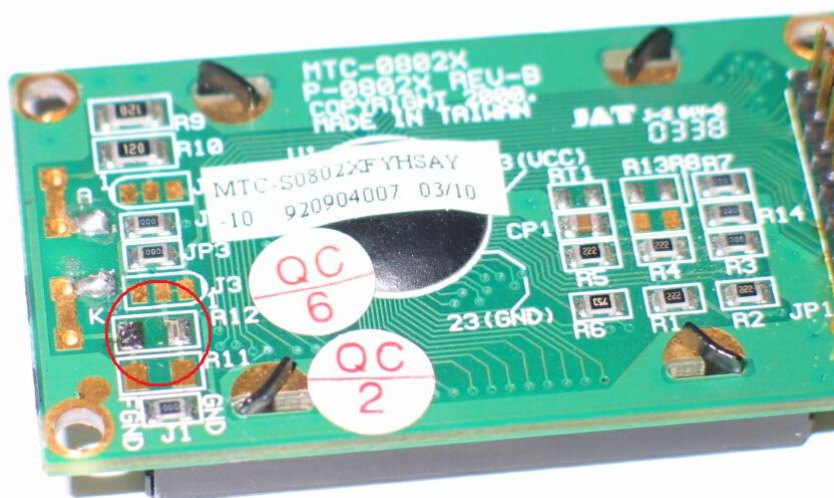
Other LCD modules may require installation of a current limit resistor (this is the case with some units from Crystal Fontz). Refer to the manufacturer datasheet for information.

Also be aware that some LCD manufacturers do not follow the standard pin configuration. **Always check the datasheet.**

NOTE: The MilesTag CORE main board uses 2 resistors (17K and 2K) to set the LCD contrast. If you use an LCD other than the Microtips module, you may need to adjust these values for proper contrast.

Buttons

NOTE: Use good quality switches and buttons. Cheap switches may have excessive electrical "bounce" resulting in reliability problems.

Serial Adapter

RS232 to TTL adapter. Most of these are based on the MAX232 level converter chip. The RS232 to TTL adapter is required for connection to the PC's serial port during score downloads (Ref Gun mode). See the section of Score Download for details.

A much simpler (inexpensive) DIY serial adapter is used for ISD Recording functions. See the section on ISD Sound Recorder for details.

Audio Input Cable

Used for ISD Sound Recording. For best results, the audio cable should use resistors to "mix" the left and right channels into a mono signal for input to the CORE main board. Otherwise the left and right channels may interact and degrade the audio quality.

Audio Adapter Cable
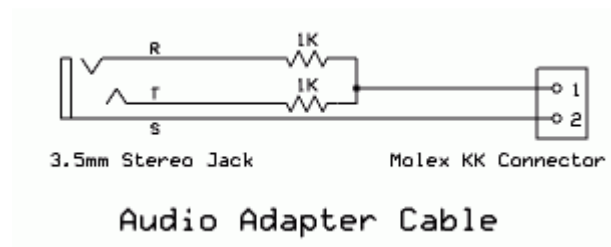
Speaker

Look for an 8 ohm speaker with a mylar (clear plastic) or treated-paper cone. This will be much more weather resistant than standard paper-cone speakers. These are widely available from electronic surplus vendors, but the quality and performance among various speakers can vary widely. You may have to experiment a bit to find a speaker that fits inside your tagger case and is efficient enough to produce loud sound levels.

Battery

Use a 7.2V NiMh or NiCad rechargeable battery pack. Look for capacity of 2400mAh to 4000mAh. Get a good quality charger that automatically switches to trickle-charge when the pack is fully charged.

How to wire the battery, charging jack and key switch.

8
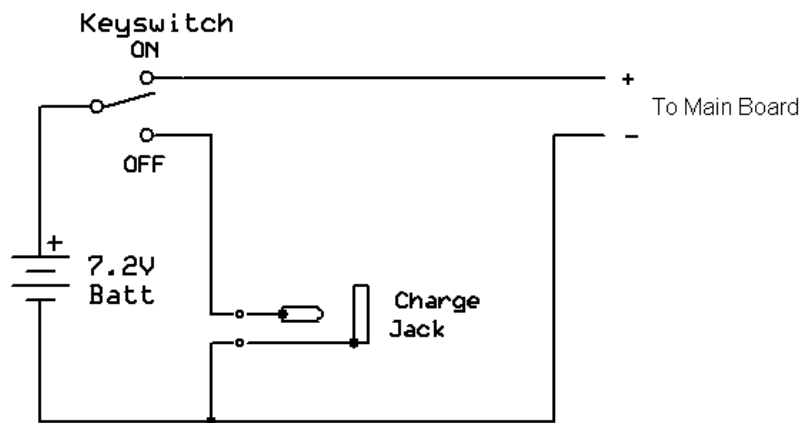
POWER ON

Some menus and functions are accessed by holding buttons on the tagger while turning the Key (power switch) ON. For two of the menus you must continue holding the button for about 3 seconds. These power on combinations ensure that certain functions are ONLY accessible to the game officials / referee.

Hold this button while turning power on:	To access this menu:	Continue holding (3 seconds) to access this menu:
MODE (Black)	Edit Gun Settings / Cloning	Change Player ID
RELOAD (Red)	Select Function (Normal / Ref Gun)	Edit Global Parameters
MODE + RELOAD + TRIGGER	Restore Factory Settings	

NORMAL POWER UP

Turn Key Switch (power switch) to the "ON" position.
> Sensor LEDs flash briefly.
> 'Ready to Engage' sound plays.

```
Combat
T.A.G.
```

If Start Delay is enabled:

```
Ready
Red
```

Hold the MODE button for 1 second to turn the LCD backlight on/off.

START GAME:
Press and hold trigger for 1 second.
> Countdown begins.
> 'Action' sound plays.
> LCD displays the Main Firing Screen.

LCD Display – Main Firing Screen

Rounds   Clips

```
R030 C20
100Eagle
```

Health PlayerID

R###	Rounds Remaining	Upper Left
C##	Clips Remaining	Upper Right
100	Health Value	Lower Left
Eagle	Player ID	Lower Right

The Player ID portion of the screen will show the ID of the last player that hit you.
After 5 seconds this reverts back to your own Player ID.

BASIC OPERATIONS

Firing
Press the TRIGGER to fire.

Reloading
Press the RELOAD button to simulate removing an empty (or partial) clip and replacing it with a full clip.

The Reload Delay simulates the time required to perform a clip change. You can initiate a Reload at any time to ensure you have a full Clip. You will not be able to fire during the Reload Delay, but can still take hits from opponents. During reloading, the Total Ammo (rounds) remaining is displayed above the Reload progress bar on the LCD.

✯ You can perform a Reload at any time. Reloading a partial clip will not result in any loss of ammo. The tagger automatically manages your ammo, so any partial clips are recombined into full clips.

✯ If you are hit during a reload, the LCD will revert to the main firing display, but you must still wait until the reload cycle is complete before firing.

Full-Auto Switch (optional)
OFF = Semi-Auto or Burst   (depending on setting of the Fire Select parameter)
ON = Full-Auto

Change Display Screens
Press the MODE button to change screens. The display will automatically revert to the Main Firing Screen when firing or Reloading. The following information is available:

Battery Status   *Indications are Full, Good, Low or WARN*
When the battery monitor reaches "WARN" it should be recharged immediately to avoid permanent damage to the battery pack. At this point, you will also hear the voice saying "Low Battery".

NOTE: The battery monitor is valid for 7.2V NiCad or NiMh rechargeable battery packs.

Elapsed Time
Elapsed time since start of game. For timed games, it is useful to check this occasionally.

Lives
Remaining "Respawns" (if enabled)

Team ID
Your Team

Flags Captured *This will only be visible after at least one Flag has been captured.*

LCD Backlight
>Hold the MODE button for 1 second to toggle LCD backlight on/off.
>Backlight automatically turns off during Firing.

Restore Default Settings (Factory Reset)
>Turn the Key (power switch) OFF.
>Hold the RELOAD, MODE and TRIGGER buttons while turning the key ON.
>>*Note: PlayerID will reset to 00 Eagle.*

Set Player ID (Tagger ID)
>Turn the key OFF.
>Hold the MODE button while turning the key ON.
>Continue holding the MODE button (~3 seconds) until "Player ID" is displayed.
>>Use the RELOAD and MODE buttons to scroll through available Player IDs.
>>Use the TRIGGER to "save" the currently selected ID and exit.
>*NOTE: Every gun must be set to a unique Player ID.*

GAME OVER MENUS
>These screens are only accessible when you are "Tagged Out" (Dead), or after receiving an End Game command from Referee Gun. Use the RELOAD button to scroll through stats.

>**GAME OVER**

>**Game Time**   T+ mins:secs This shows how long you lasted in the game.

>**Hits By**   Number of times you were "hit" by each player. Use RELOAD button to scroll through Player IDs. Only players that hit you will be displayed.

>**Last Hit**   Player that "tagged you out".

>**Tag Outs**   Number of times you were killed (tagged out). Usually this is 1 or 0 unless Respawns were allowed in the game.

>**Flags**   Number of Flags you captured.

>**Rounds Fired**   Number of Rounds you fired.

EDIT PARAMETERS

Turn the key OFF.
Hold the MODE button while turning the key ON.
The LCD displays "Edit Settings"
Press the TRIGGER to enter the editing mode.
Use the RELOAD and MODE buttons to adjust parameter values up/down.
Use the TRIGGER to "select" a value and advance to next parameter.

Team ID   Red, Blue, Yellow, Green

Assigning Players to teams enables Team Scoring and use of the Friendly Fire feature.

Friendly Fire   On / Off

When Friendly Fire is ON, players can receive hits from both their opponents (different Team ID) and their teammates (same Team ID). When Friendly Fire is OFF, players can only be hit by opponents (Different Team ID). Friendly Fire should be turned ON during "free-for-all" games (no teams).

Sounds   Mil-Sim / Sci-Fi / Silenced

This parameter affects the Firing and Reload sounds. There is no sound at the end of reload cycle when "Silenced" is selected.

Muzzle Flash   On / Off

Life   1 to 999

Starting Health value. The default setting is "100" to indicate 100% Health.

Armor   0 to 200, Off

Every Hit decreases your Armor value by "1". If you start with "5" armor points, then after 5 hits, your Armor is depleted ("0"). Armor reduces the value of all hits by ½ (regardless of Damage value). Armor does not protect you from "instant kill" devices.

Clip Size   1 to 250, UNL

Rounds per Clip. This is the number of rounds that can be fired before Reloading. Can also be set to UNL (unlimited rounds). In this case, players will not need to use the Reload button.

Clips   2 to 200, UNL

This is the total number of clips carried. Can also be set to UNL (unlimited clips).

Reload Delay   1 to 30 Seconds

Simulates the time required to reload. After pressing the RELOAD button, the LCD display will show a progress bar. During this delay, the player cannot fire but can still be hit.

Fire Select   Semi-Auto, Burst, Full-Auto

Burst Rounds   2, 3, 4, 5, 6
    Sets the number of rounds fired in each "Burst" (only if Burst is selected Firing Mode)

Cyclic Rate   250 to 800 Rounds per Minute
    Sets the Rate of Fire for the Burst and Full-Auto firing modes.
    Be cautious using high Cyclic rates with high Range values, as you can damage the IR LED!

Damage Points   1, 2, 4, 5, 7, 10, 15, 17, 20, 25, 30, 35, 40, 50, 75, 100
    Sets how many Health Points will be deducted from the opposing player when they are hit.
    With this "Variable Damage" feature, it is possible can configure different taggers in a game to
    inflict different amounts of Damage. This allows you to simulate different weapon types or
    calibers, so that "larger" weapons (e.g. a Sniper Rifle) can do more damage a "smaller" weapon
    (e.g. an SMG).

Hit Delay   0 to 20 Seconds
    Sets the delay after being hit by an opponent. During the Hit Delay, the player cannot fire or
    receive further hits.

Overheat Limit   10 to 100, Off
    The Overheat parameter is used to simulate weapon malfunction due to overheating the barrel
    by excessive sustained firing. If Overheat is enabled, the "barrel" becomes hotter with every
    round fired. This adds realism by limiting players' ability to lay down continuous suppressive
    fire, especially when using Full Auto at high rates of fire.

        ✧ The barrel "temperature" will increase with every round fired. If the temperature
        reaches the limit, then it will overheat and jam. Player must allow the barrel to cool off
        before firing again. After jamming, the LCD will show the barrel temperature.

        ✧ The barrel will automatically cool off when the player is not firing. The barrel cools
        off at a rate of "3" per second. So it will take around 33 seconds for a jammed
        (overheated) gun to completely cool. The player does not have to wait until the barrel is
        completely cooled off before firing, but the less time they wait – the quicker it will
        overheat again.

Max Respawns   1 to 20, Off
    Sets the maximum number of Automatic Respawns. Setting this to "Off" will disable Automatic
    Respawns. The number of remaining respawns is displayed on the Gun Displays as "Lives ".

Zombie Mode   On / Off

This parameter is not available if "Respawns = Off".

If Zombie Mode is ON then all players assigned to the Red Team are the "Zombies". When a player on any other team is killed they will respawn as a Zombie. See the section on Zombie Mode for more details.

Auto Respawn Delay   10 to 180 Seconds

This parameter is not available if "Respawns = Off".

Sets the delay time for Auto-Respawns.

Start Delay   0 to 240 Seconds

Death Delay   0 to 120 Seconds

This provides a delay after a player is Tagged Out. During this delay the Sensor Hit LEDs remain ON and the LCD displays "Get Medic" along with a countdown timer. A medic can "revive" the player by adding health points or the player can revive themselves by reaching a medic station (medic box) before the timer expires. If the player does not receive help in time - they are OUT.

Game Time Limit   0 to 120 Minutes (0 = no time limit)

GLOBAL PARAMETERS

IR Power   Indoor / Outdoor
    This sets the maximum power (and range) of the Infrared Emitter. Indoor environments should use Indoor mode to limit reflections and "bounce shots" from walls and objects.

Range   Min to Max
    When using Outdoor mode, the ideal range setting is "60%". Higher settings (along with higher cyclic rates) may overdrive the Infrared Emitter and eventually degrade its performance due to overheating. Note that the effects of the Range parameter are much more profound when using the Indoor mode.

    This requires some experimentation to determine the ideal settings for your environment.

Carrier   38 KHz, 40 KHz, 56 KHz
    This sets the "transmit" carrier frequency. Therefore it MUST be set to the same frequency as the sensors. All taggers in a game must use the same frequency.

Game Box RoR   Yes, No
    Yes = Game Boxes can be re-used if the Player was respawned.
    No = Game Boxes are one-time-use per player.

Game Box Stay   Yes, No
    Yes = Game Boxes allow unlimited use.
    No = Game Boxes are one-time-use per player.

Full Ammo RoR   Yes, No
    Full Ammo 'Reset on Respawn'. When this parameter is set to "Yes", the player will receive their full initial ammo loadout during any respawn.

    If set to "No", the player will continue with the same Ammo they had when they were killed (tagged out). This can be useful to prevent players from 'self-sacrificing' (allowing themselves to be killed) in order to gain more Ammo.

Kill LED   1 second to 240 seconds
    Sets the timeout for the Sensor "Hit" LEDs. The LEDs will automatically turn off after this delay to conserve battery power.

CLONING: The Cloning feature enables the operator to quickly "copy" game settings from one tagger to another. All data is transmitted over the infrared link so no cables are required. The cloning function is also used to assign Team IDs and to synchronize the Global parameters on each tagger.

✶ Cloning can be performed by ANY tagger without need for a dedicated referee device.

✶ After a successful clone, the receiving tagger will indicate "Clone OK" and play the power up sound.

Cloning Operation – Use any tagger as the "Host".

1. Turn Host Tagger OFF.
2. Turn Host Tagger ON while holding MODE button.
3. Press Trigger to access "Edit Preset1".
4. Edit Game and Weapon settings as required.
5. Press Trigger at "Save Settings".
6. Host Tagger will display "Clone Team A".
7. Aim Host tagger at sensor of receiving tagger.
8. Press trigger to initiate Cloning.
9. Receiving tagger will display "Clone OK" and play Power-up sound.
10. Repeat steps 7. to 9. if "Error" occurs.
11. Repeat cloning for remaining Team A (Alpha) taggers.
12. Use BLACK button to select "Clone Team B".
13. Repeat steps 7. to 9.
14. Use MODE button to select "Exit Config".
15. Press Trigger to return Host Tagger to normal operation.

All Taggers should now display "Ready" and the assigned team (Red, Blue, Yellow, Green). This allows game officials to verify correct team assignments prior to game start.

The Team ID of the Host Tagger is set in the Edit Menu.

SCORE DOWNLOAD

Collect Player Scores on Referee Gun – The Ref Gun is used to collect and compile score data from each tagger. This is done via infrared so no cables are required, and can easily be done in the field.
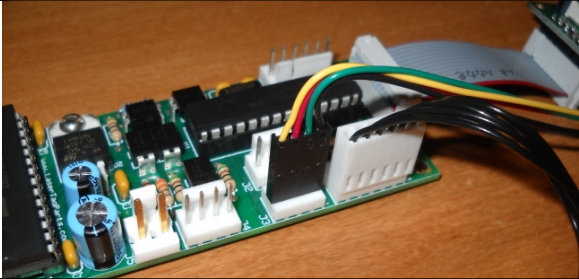1. Use the Ref Gun "End Game" command to end any players that were not Tagged Out.
2. Clear all previous score data in the Ref Gun: In the Service Controls menu, select "Clear Scores". Press Trigger.
3. Prepare Ref Gun to collect Score data: In the Post Game Controls menu, select "Collect Scores".
    NOTE: Pulling the trigger while in the "Collect Scores" mode will send the "End Game" command. This avoids switching between menus while collecting scores.
4. Players can now download scores to the Ref Gun.
    a. Tagger must be in the Game Over menus.
    b. Point barrel at Ref Gun sensor (close range).
    c. Pull and hold the TRIGGER.
    d. Press the MODE button momentarily to start score transmit - indicated by "beep".
    e. Keep barrel in place (aimed at Ref Gun sensor) until second "beep".
    f. Watch Ref Gun LCD for confirmation notices or errors.
        "Good Scores" is displayed at end of successful transfer.
    g. If any errors, repeat steps a. through e.
    h. Score data transfer takes about 3 seconds.
    i. Repeat this process for each player.
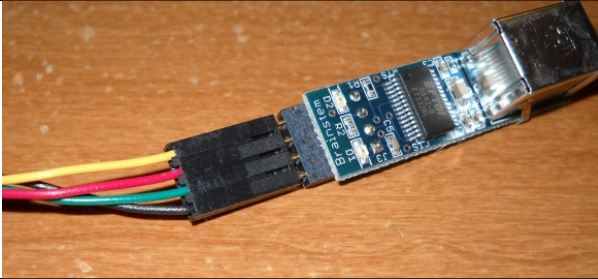
   If any player attempts to download scores twice, the Ref Gun will recognize this and indicate "Data Exists". This prevents corruption of the previously collected data.

Transfer Player Scores to PC – Data is transferred from the Ref Gun to the PC as ASCII characters using RS232 serial data format (8N1). Data is formatted into rows and columns using tab and line feed characters.
1. Connect Ref Gun serial port to PC serial port (or USB port depending on cable used).
2. On PC, open scoring software or terminal program and enable "Capture to Text" if required.
3. On Ref Gun initiate transfer of compiled score data to PC: In the Post Game Controls menu, select "Print Scores". Press Trigger.

USB Adapter (Acroname Part # S22-USB-SERIAL-INT-CONN) www.acroname.com

Attach adapter cable to the RevH Main Board. The pinout matches the extension cable sold by acroname. *NOTE: For RevG boards the serial connector pinout is different.*	Here is the connection to the Acroname USB interface. The adapter is powered by USB. If you are using a RevH board as your Referee controller, you can install the USB adapter in the same case.

Example Score Data for 3 Players:

#	Name	Team	Hit You	Hit Enemy	Hit Friend	Flags Scored	Rounds Fired	Rounds Scored	Tagged YouOut	Number Respwn	Game Time
007	Blaze	Delta	10	11	0	0	25	045%	1	0	001:25
025	Rambo	Bravo	7	11	0	0	63	018%	0	0	001:58
026	Snake	Alpha	10	5	0	0	15	034%	1	0	001:04

```
Individual Scores:
Blaze  +00055
Rambo  +00055
Snake  +00025

Team Scores:
Alpha  +00050
Bravo  +00110
Charl  +00000
Delta  +00110
```

#	Player's ID number
Name	Player's handle
Team	Player's Team
Hits	Number of times Player was hit
Score	Number of times Player hit an opponent or teammate
FF Hits	Number of times Player hit a teammate
Flags	Number of flags collected by Player
Rnds	Number of rounds fired by Player
Accur	Percentage of shots landed by Player (accuracy)
TagOut	Number of times Player was tagged out
Respwn	Number of times Player was respawned
Time	Elapsed time at end of game

PLAYER ID / CALL SIGN: Each tagger must be set to a unique Player ID to allow correct operation of the scoring features. You can permanently assign an ID to each gun, or allow players to select their Call Sign prior to the game. It may be helpful to label each tagger with the Call Sign.

✼ When you are tagged by another player, the Call Sign of the player that tagged you will appear in your LCD display for a few seconds.

✼ The Player ID is not affected by Cloning or Mode Reset. Performing a Factory Reset will reset the Player ID to "00 Eagle". Individual Call Signs cannot be edited as they are permanently set in the firmware.

PLAYER ID	HANDLE		PLAYER ID	HANDLE		PLAYER ID	HANDLE
00	Eagle		25	Rambo		*ID 50 is reserved for MicroMT systems.*	
01	Joker		26	Snake			
02	Raven		27	Audie			
03	Sarge		28	Sting		*ID 51 and 52 are Crew Served Weapons.*	
04	Angel		29	Zeena			
05	Cosmo		30	Bugsy			
06	Gecko		31	Viper		*Hits received from ID 50-56 will use the TeamID and count toward Team Scores.*	
07	Blaze		32	Jewel			
08	Camo		33	Genie			
09	Fury		34	Logan			
10	Flash		35	Razor		*Hits received from ID 53-59 will trigger Sound #03 (explosion sound). Hits from ID 57-59 are not affected by Friendly Fire settings or Armor settings.*	
11	Gizmo		36	Slick			
12	Homer		37	Venom			
13	Storm		38	Rocky			
14	Habit		39	Saber			
15	Click		40	Crush		50	Micro
16	Ronin		41	Titan		51	LgtMG
17	Lucky		42	Orbit		52	HvyMG
18	Radar		43	Vixen		53	ZOOKA
19	Blade		44	Tank		54	ROCKT
20	Ninja		45	Rogue		55	GRNDE
21	Magic		46	Sheik		56	CLYMR
22	Gonzo		47	Gizmo		57	MINE
23	Cobra		48	Siren		58	BOMB
24	Pappy		49	Dozer		59	NUKE

MODE RESET: The Mode Reset initializes all gun/game parameters and most Global parameters to their factory values. The Player ID setting is NOT affected.

> To initiate a Mode Reset:
> 1. Turn Power OFF
> 2. Press and Hold the RELOAD and MODE buttons while turning power ON.
> 3. LCD will indicate "Mode Reset" and Firmware Version.
> 4. Release buttons.
> 5. After Reset the tagger will boot up in Preset 1 with default game settings.

FACTORY RESET: The Factory Reset initializes ALL memory locations. This is usually only required when the tagger is first initialized at the manufacturer, or after a firmware update (chip replacement). It should not be required during normal operation.

> To initiate a Factory Reset:
> 1. Turn Power OFF
> 2. Press and Hold RELOAD, MODE and TRIGGER while turning power ON.
> 3. LCD will indicate "Factory Reset".
> 4. Release buttons.
> 5. After Reset the tagger will boot up in Sport Mode with default game settings.

> NOTE: After performing a Factory Reset, you will need to set the Player ID and adjust Global Parameters as required.

CLARIFICATIONS

Respawn vs. New Game: Do not "Respawn" players to start a new game. When a player is respawned, they are brought back to life to continue the *same* game. The game timer and scores are not reset by a Respawn. The New Game command will reset the game timer and scores and initialize the player for a new game.

> Respawn   = Continue playing same game
> New Game   = Reset player for a New Game

Respawns and Timed Games: When using a timed game (Game Time > 0), the auto-respawn function will not work after the game time ends (Game Over) even if there are still respawns available. Also, players can not be respawned by Referee or Respawn stations after game time ends.

Bolt-Action (or Pump-Action) Simulation: In some cases you may want to configure a tagger to simulate a single-shot weapon, where the player is required to reload after every shot. To do this, set the Firing Mode to "Semi-Auto", set the Clip Size to "1" and set the Clips to the number of single-shot rounds the player will carry. Set the Reload Delay to simulate the time required to work the "action". Now the player must hit the Reload button between every shot. This is useful for "Sniper" weapons with high damage values, as it limits the rate of fire and leaves the Sniper vulnerable while reloading.

100% Health: In many game scenarios, you may wish to set the starting Life value to "100" points representing an overall starting "health" of 100%. This simulates the game design concept of popular PC/Console games and should be familiar to most players.

Auto Respawn: Auto Repawn (as the name implies) will automatically respawn a "tagged out" player after a programmable delay. The maximum number of respawns allowed is set by the "Respawns" parameter. The delay period is set by the "AutoResp" parameter in the Global Menu.

✷ This allows players to be respawned without Referee interaction, or needing to return to a "respawn point".

✷ The LCD display will show a countdown until respawn. Game rules should dictate whether players are allowed/required to move while they are waiting to respawn.

✷ Scores are not cleared or reset by a respawn.

ZOMBIE MODE

Zombie Mode is designed to provide a very unique and fun (and creepy) game scenario.

First, if you have *never* seen one of the many zombie movies released over the past 60 years, go rent one and watch it (with the lights on of course). Then come back here to continue reading…

Okay, now that you grasp the basic rules of human / zombie interaction, we can continue.

Here's how the game works: The players are divided into 2 teams. One team is the "Humans" and the other team is the "Zombies". The Zombies, as their nature dictates, must try to kill the Humans. The Humans, in the interest of self-preservation, must try to kill the Zombies. So far this sounds like your standard "Team Elimination" scenario, right? Well, not so fast, movie fans. Here comes the creepy twist: When a Human is killed, after a short delay, they will come back to life….. as a ZOMBIE! (it's okay to scream)

As you have probably figured out, this will create an ever-increasing problem for the Humans as the Zombies gain new recruits from the ranks of "dead Humans". If the Humans don't thin out that relentless horde of un-dead opponents, they may soon be outnumbered and overwhelmed.

> **Important note for Humans:** One thing that the Humans will have on their side is that dead Zombies STAY dead. Dead Zombies do NOT come back to life. At least that's the rule for MilesTag Zombies. Your movie may have been different, but in MilesTag…. They're out!

What does a Zombie look like?   In the movies, the Zombies are generally pretty easy to pick out. They walk funny, they tend to be quite unattractive and – if you are a Human – they are the ones chasing you. In MilesTag we don't have time for scary make-up and learning the "zombie walk"… so we'll just make the Zombies' head sensors flash on and off. So you can clearly see them 'coming for you'. Zombies aren't good at hiding anyway.

What do Zombies eat? In MilesTag, the Zombies aren't hungry for brains. So they don't have to catch you like the ones in the movies. But MilesTag Zombies ARE well-armed and a bit harder to kill than your average Human. And, since we can't make them *move* slower, we will settle for making them *shoot* slower. The Zombies will have to reload after every shot (bolt-action).

Dead Humans If you are a human and you get killed, don't worry. Just stay where you are and wait for the "transformation" (auto respawn). If you are a human and your teammate gets killed, worry. There's no question that he is coming back as a zombie and you need to get away… quickly.

"Standard Issue" Zombies In MilesTag, the Zombies have certain fixed settings. Whether a player starts as a zombie or respawns from human to zombie, these "zombie settings" will be adopted automatically and cannot be changed. They will have 200 life points so they are harder to kill. They can only fire one shot at a time (bolt-action) with a damage setting of 10 points and a 1-second reload delay to simulate their limited aptitude for weapons.

Human Settings The settings for Humans are not limited, but we do have some suggestions. Humans should be set to 100 life points to simulate "normal life".

Team Assignments The RED team is the Zombies. The BLUE team is the Humans. Be careful in deciding how many players are assigned to each team. Remember that the Zombie team gains in size as human players are eliminated. You should balance the team sizes against how well-armed the humans are.

<u>Zombie</u>		<u>Human</u>	
Team	= Red	Team	= Blue
Health	= **200**	Health	= 100
Clip Size	= **1**	Clip Size	= ___
Clips	= **200**	Clips	= ___
Damage	= **10**	Damage	= ___
Reload Delay	= **1 second**	Reload Delay	= ___
Hit Delay	= **.25 second**	Hit Delay	= .25 second
Fire Select	= **Semi**	Fire Select	= ___
Respawns	= 1	Respawns	= 1
Resp Delay	= 60 seconds	Resp Delay	= 60 seconds

BOLD items are "fixed" values for Zombies

Suggested Rules for Zombie Games

1. When Humans are killed, they may not move until they are respawned as a Zombie.
2. When a Zombie is killed, they must leave the field immediately.

MENU	PARAM	RANGE	Function	Cloned	Mode Reset Value	Factory Reset Value
Boot[1]	Mode	Normal, Ref Gun	Sets the active mode. The system will power up in the last mode with all game parameters intact.	No	Normal	
Gun ID[3]	Player ID	0-49	Player ID and Handle. Each gun should be set to a different ID to allow scoring. The 5-character names (handles) assigned to each ID cannot be edited.	No	No Change	0
Global[2]	IR Power	Indoor, Outdoor	Indoor = Lower IR power to limit reflected shots (IR bounce).	Yes	Outdoor	
	Range	Min to Max	Adjusts IR modulation power. Effect is more noticeable using Indoor mode.	Yes	60%	
	Carrier	38,40,56 KHz	IR Carrier Frequency	No	56KHz	
	Medi Box	0 to 100 Pts		Yes	50	
	Ammo Box	0 to 20 Clips		Yes	2	
	Game Box Stay	Yes, No		Yes	No	
	Game Box RoR	Yes, No		Yes	No	
	FullAmmo RoR	Yes, No	Ammo Reset on Respawn	Yes	Yes	
	Volume	0 to 7	0 = Loudest, 7 = Quietest (RevH only)	No	No Change	2
	Kill LED	1 to 240 sec	Timeout for Sensor LEDs after player is tagged out (killed).	Yes	No Change	240

[1] Boot Menu = hold the RELOAD button while turning power ON.
[2] Global Menu = hold the RELOAD button while turning power ON and continue holding for ~3 seconds.
[3] Gun ID Menu = hold the MODE button while turning power ON and continue holding for ~3 seconds.

MENU	PARAM	RANGE	Function	Cloned	Mode Reset Value	Factory Reset Value
Edit Settings	TeamID	Red, Blue, Yellow, Green		---	Red	
	FrndFire	Yes, No	Friendly Fire. Yes = same team hits are allowed and scored.	Yes	Yes	
	Sounds	MilSim, Sci-Fi, Silencer	Changes the main firing sound and the reload action sound.	Yes	Sci-Fi	
	MuzFlash	On, Off	Enable or disable muzzle flash	Yes	On	
	Life	1 to 999	Initial health value	Yes	100	
	Armor	Off, 5 to 200		Yes	Off	
	ClipSize	1 to 250, UNL	Rounds per clip	Yes	30	
	Clips	2 to 200, UNL	Number of clips	Yes	20	
	Reload	1 to 30 Sec	Reload delay time	Yes	2 Sec	
	Fire Sel	FullAuto, SemiAuto, Burst	Firing mode (Burst = 3-rd burst)	Yes	Burst	
	Burst	2 to 6 Rnds	Burst rounds	Yes	3	
	Cyclic	250 to 800 RPM	Rate of fire in rounds-per-minute (RPM)	Yes	500	
	Damage[4]	1 to 100	Sets the damage inflicted to opponent by each "hit"	Yes	1 Pts	
	HitDelay	.00 to 20 Sec		Yes	1 Sec	
	Overheat	Off, 10 to 100	When enabled (On), sustained firing will cause the gun to "overheat"	Yes	50	
	Max Resp	Off, 1 to 20	Max number of auto-respawns. Off = disabled	Yes	0	
	Zombie	On, Off				
	AutoResp	10 to 180 Sec	Auto-respawn delay time in Seconds	Yes	30 Sec	
	StartDly	0 to 240 Sec	Delayed game start	Yes	0	
	DeathDly	0 to 120 Sec	Death Delay time, 0 = disabled	Yes	0	
	GameTime	0 to 120 Min	Time limit for game in minutes. Set to "0" for unlimited time	Yes	0	

[4] Sixteen available Damage values [1, 2, 4, 5, 7, 10, 15, 17, 20, 25, 30, 35, 40, 50, 75, 100]

ISD1700 Sound Programmer (Windows)

The sound programmer application allows you to record sound effects into the ISD1790 chip without removing it from the MilesTag CORE main board. The main board firmware (V5.40 and later) includes a programming mode that works with the PC application to install/erase/test sounds recorded to the ISD1790 chip. You can also install custom sound effects by renaming your custom .wav files and placing them in the same folder as the programmer application. Be sure to observe the maximum length allowed for each sound effect.
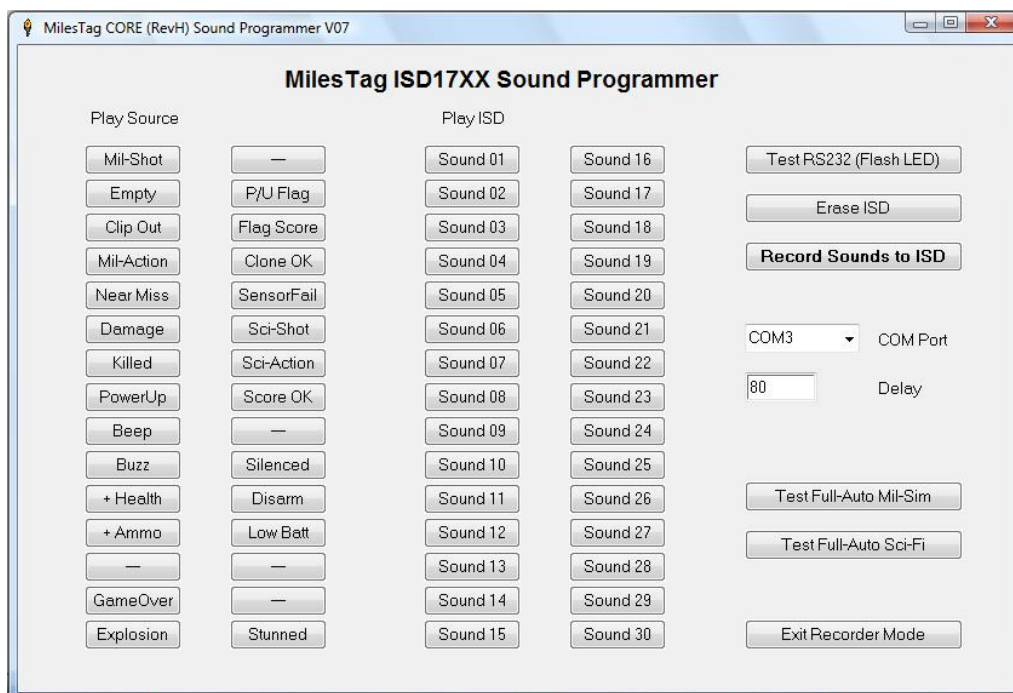
The ISD Sound Recorder software was written in Liberty Basic.   Source code is available at www.lasertagparts.com.

Sound Programmer Setup

1. Connect PC audio line out or headphone out to the CORE main board Audio Input.
2. Connect PC Serial Port to CORE Serial Port using adapter cable.
3. Start MilesTag Core Sound Programmer application.
4. Set CORE system to "Ref Gun" mode.
5. Select "Edit Sounds" under "Service Controls".
6. LCD shows "Sound FX Ready"
7. Set COM Port as required.
8. To test COM Port and serial connection, click on "Test RS232" button.
9. The sensor LEDs should flash briefly to indicate connection OK.

   NOTE: All audio from the PC is routed to the CORE's audio amplifier and speaker. This way you can test the audio quality of the recording and the source through the same speaker (A/B comparison).

Sound Programmer Operation

        Delay - 1 to 100, adjusts for PC timing if sounds are cut off or starting late.

        Play Source - Plays the PC sounds (source) through the CORE system speaker.

        Play ISD - Plays the recorded sound from the CORE internal sound chip (ISD1790).

        Erase ISD - Erase ALL sounds on the CORE internal sound chip.

        Record Sounds to ISD - Record ALL sounds to CORE internal sound chip.

        Test Full-Auto - Plays the firing sound (Mil or Sci-Fi) rapidly for testing purpose.

            If the Full-Auto does not sound correct - edit the .wav file or adjust the DELAY.

        Exit Recorder Mode - Press this when you are done recording BEFORE powering the main board OFF. If you do not do this, some sounds may be corrupted.

Custom Sounds

Remember to back up (or rename) the original .wav files in the Sound Programmer folder before replacing them with your new sounds.

For best results, use an audio editor to convert your .wav files to mono and trim any silence from the beginning and end of the file.

REFEREE GUN

Referee Controls:

End Game:	Force player to "Game Over" - no change to scores.
New Game Now:	Restart player – clear all scores/stats.
New Game Ready:	Restart player – clear all scores/stats.
Admin Kill:	Instantly "kill" player – add one "tagout" to scores.
Admin Respawn:	Restart player – add one "respawn" to scores (continue current game).
Admin Pause:	Pause player – no change to scores.
Start Game:	Start a "paused" player – no change to scores.
Restart Clock:	Set player's elapsed game timer to "000:00".
Restore Ammo:	Set player to Full Ammo (initial ammo loadout).
Test Sensor:	Test player's sensors (flash and audible).

Post Game Controls:

Collect Scores:	Receive and compile scores from players via Infrared.
View Scores:	View Individual and Team compiled scores.
Print Scores:	Transmit compiled scores to PC terminal. RS-232 @9600 baud (8N1).

Service Controls:

Clear Scores:	Clear all internal Score Data from Referee Controller.
Edit Sounds:	Enter ISD Sound Programmer Mode (RevH only).
Print Test Data:	Send "dummy" data to PC to test serial connection/terminal.
Data View:	Display first 2 bytes of data received by sensors.

|		MilesTag CORE RevH Sound Effects			
ORDER	SOUND	MAX LENGTH	ORDER	SOUND	MAX LENGTH
1	Shot (Mil-Sim)	1500mS	16	---	1000mS
2	Empty Chamber	1000mS	17	+ Flag	2000mS
3	Start Reload (Clip Out)	1000mS	18	Flag Score (siren)	6000mS
4	End Reload (Mil-Sim)	1500mS	19	Clone Okay	2000mS
5	Near Miss	1500mS	20	Sensor Fail	1000mS
6	Hit - Damage	2000mS	21	Shot (Sci-Fi)	1000mS
7	Dead	3000mS	22	End Reload (Sci-Fi)	1000mS
8	Power Up	4000mS	23	Scores Okay	1000mS
9	Beep	1000mS	24	---	1000mS
10	Buzz	1000mS	25	Shot (Silenced)	1000mS
11	+ Medic	1000mS	26	Disarm Player	1000mS
12	+ Ammo	1000mS	27	Low Battery	1500mS
13	---	1500mS	28	---	1500mS
14	Game Over	4000mS	29	---	1000mS
15	Explosion	3000mS	30	Stunned	1000mS

NOTE: Make sure your sound effects fit the maximum length. If sounds are longer than the allotted space, they will be cut short during recording.

ISD SOUND PROGRAMMER SERIAL CONNECTIONS

When you connect the RevH board to your PC serial port for the ISD Recorder Application, do NOT use an RS232/TTL adapter such as the one used for score download on the Ref Gun. During ISD record functions, the serial port is configured specially to allow constructing a simple adapter cable using one 20K resistor. In this way, you can permanently fit a serial connector on every gun without the more expensive level-conversion adapters.

RevH Serial Adapter for ISD Recorder
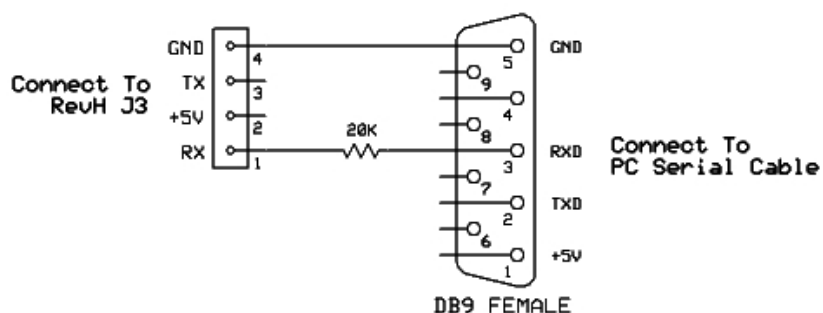
Audio Input Cable
> Used for ISD Sound Recording. For best results, the audio cable should use resistors to "mix" the left and right channels into a mono signal for input to the CORE main board. Otherwise the left and right channels may interact and degrade the audio quality.
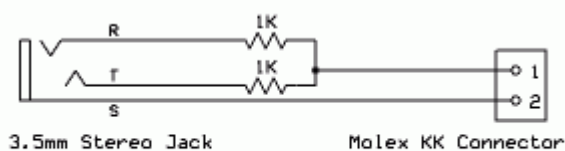
Audio Adapter Cable

Alpha
Bravo
Charlie
Delta
Echo
Foxtrot
Golf
Hotel
India
Juliet
Kilo
Lima
Mike
November
Oscar
Papa
Quebec
Romeo
Sierra
Tango
Uniform
Victor
Whiskey
X-ray
Yankee
Zulu

Admin   Administrator, Game Official, Referee

Clone   copy settings from one tagger to another using infrared link (wireless)

Cyclic   The 'cyclic' or 'cyclic rate' is the rate at which a weapon can fire successive rounds also referred to as 'Rate of Fire'; specified in Rounds-per-Minute

FET   Field Effect Transistor.

Friendly Fire Hits received from players on your own team. With the MilesTag system you have the option to turn Friendly Fire on or off. When Friendly Fire is turned off, you will not be able to shoot your teammates.

Hit-Delay   After a player is hit, this is a delay time during which the player cannot shoot or be hit by opponents, the player is effectively 'locked out' during the Hit Delay.

IR   Infrared

LED   Light Emitting Diode

Mil-Sim   Military Simulation

Muzzle Flash Visible flash of light emitted from a gun barrel during firing; simulated by bright LEDs

Respawn   To bring a player back to life. Allows player to continue playing.

WoW   Worlds of Wonder, refers to a very simple IR signal used in older Laser Tag gear. The latest MilesTag operating system does not support the WoW protocol.

NOTES:

MilesTag IR Data Transmission Format

First Bit Transmitted (0=Shot, 1=Control)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Shot Packet

1	7	2	4
0	PID	TID	Damage

```
PID = Player ID (50 Players)
      0 to 49    -Players
      50 to 49   -Grenades, Mines, Crew Served Weapon, Special, etc.

TID = Team ID (4 teams)
      Red
      Blue
      Green
      OPFOR

Damage = 16 Values (each weapon can inflict different damage)
```

Control Packet

1	7	8	
1	Control ID	Data	… additional bytes …

```
Referee Control Signals
      Respawn Player
      End Game
      New Game
      Test Sensors
      etc

Game Devices
      Medic Box
      Flag Stations

Data Transfers
      Cloning (Tagger Settings)
      Score Download
```

IR Modulation

```
Infrared LED:    940nm
LED current:     1500mA / 100mA
Carrier:         56KHz PWM, variable duty cycle
Data Encoding:   Pulse-Length Modulation, 600uS time base
```


34

Keep analog and digital power traces separate.
Refer to ISD1790 datasheet for guidance.

C7,C8,C11 = 0.1uF

1N4001
+5V

C11
C8
C7

21
14
1

ISD1790

4 MISO
5 MOSI
6 SCLK
7 /SS

20
17
9

28 16 12
8

60K4 1%
39K
+5V

AUDIN
C9
.1uF
+

J7
1
2
SPKR

TDA7052
8
7
6
5
1
2
3
4

C12
.1uF
+7.2v

C10
2.2uF
1M

J6
5
6
AUX I/O
+5V

J1
6 SW1 Trigger
5 SW2 Reload
4
3 SW3 Mode
2
1

J2
4 Data
3 +
2 -
1 Hit LED
+5V
Sensor

51
IRLD110

J3
4 -
3 TX
2 +
1 RX
Serial
+5V
C4
.1uF

10K
10K
10K
+5V

MOSI
SCLK

/SS
MISO

U1
PIC18F2525

28 RB7
27 RB6
26 RB5
25 RB4
24 RB3
23 RB2
22 RB1
21 RB0
20 VDD
19 VSS
18 RC7
17 RC6
16 RC5
15 RC4

1 RE3
2 RA0
3 RA1
4 RA2
5 RA3
6 RA4
7 RA5
8 VSS
9 OSC1/RA7
10 OSC2/RA6
11 RC0
12 RC1
13 RC2
14 RC3

LCD DB4
LCD DB5
LCD DB6
LCD DB7
LCD EN
LCD RS

X1 16MHz
C5 22pF
C6 22pF

PWM

IRLD110
IRLD110
51
IRLD110
51
IRLD110
3.3

+7.2v
+5V
4K7
+5V
1K65 1%
1K65 1%
+7.2v

J4
1
2
3
4
IR
MZ
Infrared LED TSAL6100
TLDR5800 Muzzle Flash

J6
1 Semi/Full
2 SW4
3 BKL +
4 -
Backlight
+5V
IRLD110

2x8 LCD DISPLAY

N.C. A
K Backlight
3 Contrast
17K
2K
+5V
2

1
5
6
4
7 8 9 10
No Connection

11 DB4
12 DB5
13 DB6
14 DB7
RS
EN

L4941
U2
In Out
Com

C1 330uF
C2 100uF
C3 .1uF
+7.2v
+5V

J5
1 -
2 +
BAT

Combat TAG, LLC
MilesTag CORE RevH
J. Robertson
4 Mar 2010