

InterceptLink

Air Flow Meter Correction

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By Link ElectroSystems Ltd.

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1. INTRODUCTION

The INTERCEPT is a product that allows the fuel curve on a factory Engine Management System to become fully adjustable. This is achieved by scaling the Manifold Air Pressure (MAP) or Air Flow Meter (AFM) signal, before returning it to the factory ECU. Fuel corrections can then be made from a 3-Dimension Zone Table which is designed to map all the operating conditions of the engine. This will allow the mixture requirements to be adjusted at any load condition, optimising both engine performance and economy.

The aim of the Intercept is to provide a quick tune-up tool for engines that require mild mixture adjustment. There are only 6 wires to connect and when initially powered up, the AFM/MAP signal voltage is passed directly without scaling to the factory ECU. This has the advantage of allowing the engine to run as previously configured, immediately after an installation. From this point fuel corrections can begin via the use of the Zone Table.

1.1 Zone Table

The Zone Table is a rectangular grid formed using engine RPM and engine load. It uses 9 ROWS by 16 COLUMNS and a copy can be found in the centre of this manual. It contains 144 small zones and 24 large zones, all acting independently. Each zone therefore represents a unique engine operating condition, allowing fuel changes to be made in small, localised areas. Initially all zones equal zero, representing no change to the AFM/MAP signal. If a positive number is entered the mixture will be made richer. Likewise a negative number will produce a leaner mixture. The bigger the number the greater the effect.

RPM

The engine RPM spans the horizontal axis of the Zone Table and is divided into 500 RPM steps. The Intercept operates in the column related to the current engine speed and implements any fuel correction entered by the user.

LOAD AXIS

The Load Axis indicates engine load and forms the vertical axis of the Zone Table. The Intercept operates in the row related to the current engine load and can be spanned with 2 options.

- **Throttle Position Sensor (TPS):** This is the recommended method allowing the Intercept to use the factory TPS. It requires minimal setup time and has the flexibility of allowing the operator to select the number of row available for tuning. This option can be selected when intercepting a MAP or AFM signal.

NOTE - A Throttle Switch cannot be used.

- **Calculation:** If the engine does not have a TPS the INTERCEPT must generate a LOAD AXIS. How this is calculated will depend on which signal is being intercepted.

Intercept AFM: The AFM does not form a direct indication of engine load, so the Load Axis must be calculated from engine RPM and AFM voltage. The INTERCEPT will automatically set up this Axis and requires the vehicle to be driven during this process. The number of rows available for tuning are fixed.

Intercept MAP: The engine load is directly proportional to the Manifold Air Pressure. The 0- 5 Volt output of the MAP Sensor can therefore be scaled directly to lie between 0 - 240 on the Load Axis.

2. SYSTEM INSTALLATION

2.1 Trigger

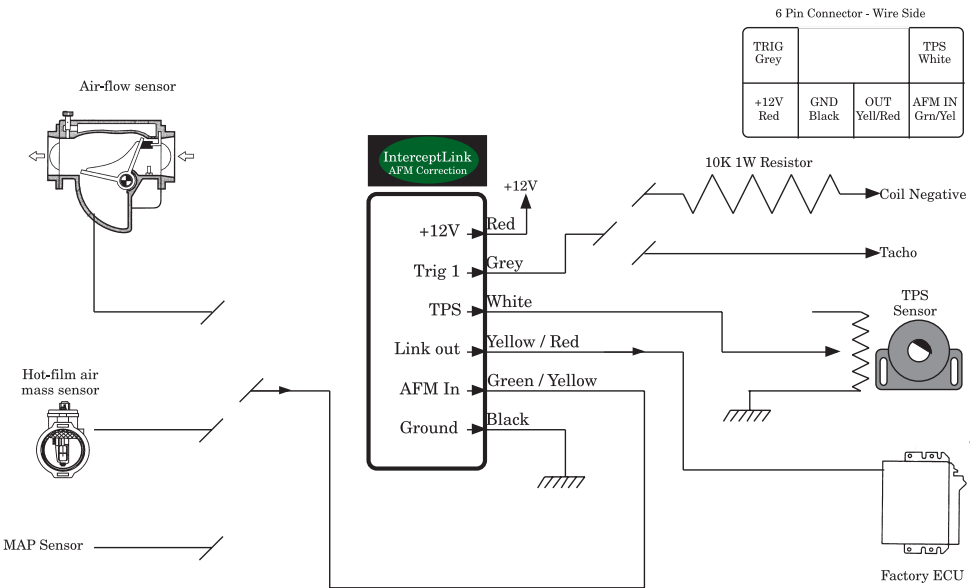
There are 2 options available when selecting the trigger signal used by the INTERCEPT. Dip Switch 1, located inside the unit controls this.

Trigger High – This uses the coil negative signal. The 10k Resistor supplied must be connected as close to the coil as possible. Set DIP Switch 1 to ON.

Trigger Low – This uses the Tacho signal derived by the factory ECU. This signal can be connected directly to the INTERCEPT. Set DIP 1 to OFF (Default).

2.2 Installation Diagrams

INTERCEPT WIRING DIAGRAM



InterceptLink

3. SETUP PROCESSES

The Setup Process allows the INTERCEPT to be configured. With the Remote connected, apply power to the INTERCEPT and follow these steps. Note that changes made during steps 4-10 will be automatically saved.

STEP 1 - Cylinder Number

Scroll to the CYLINDERS menu and check the setting is correct. Use the ADJUST buttons to change the setting remembering to store the changes. Switch off the power and proceed to STEP 2

STEP 2 - Trigger Stability Check

Now start the engine with the display on TEST RPM. Check to ensure the RPM is stable by observing idle RPM and then revving the engine. This is important as the RPM is used to span the Zone Tables horizontal axis. Leave the engine running and proceed to STEP 3.

STEP 3 - Voltage Check

Scroll to the voltage menu using the SELECT UP button. This menu will show 'x.xxAFM y.yyVECU'. 'x' represents the AFM/MAP voltage and 'y' indicates the voltage returned to the factory ECU. At this point with no changes in the Zone Table, these two readings should indicate the same. This means the AFM/MAP signal is being passed directly without scaling to the factory ECU. If the screen shows 'OFFLINE 0.0 VECU' this means the AFM or MAP signal is not connected to the INTERCEPT and the wiring should be checked.

If intercepting a MAP signal proceed to STEP 4 and leave the engine running. Otherwise use the following procedure to determine the AFM type

- With the engine idling note the AFM Voltage.
- Now Rev the engine and observe the voltage change. There are two AFM types:

Type A AFM: - Voltage at idle <(less than) Voltage at WOT (Wide Open Throttle)

Type B AFM: - Voltage at idle >(greater than) Voltage at WOT

This information will be used in STEP 5. Proceed to STEP 4 and leave the engine running

STEP 4 - Intercept Mode

Scroll to the 'INTERCEPT -> AFM' menu using the SELECT UP Button. This menu will allow the INTERCEPTS mode to be selected.

- 'INTERCEPT -> AFM' - Use this mode when intercepting the Air Flow Meter signal. Select this by pressing the ADJUST UP Button.
- 'INTERCEPT -> MAP' - Use this mode when intercepting a MAP Sensor signal. Select this by pressing the ADJUST DOWN Button.

Press the SELECT UP button once. If the AFM is being intercepted then go to STEP 5, otherwise skip to STEP 6.

Leave the engine running.

STEP 5 - Air Flow Meter Select

This menu will display 'AFM -> TYPE A'. This will allow the AFM Type to be selected.

- 'AFM -> TYPE B' - Selected by pressing the ADJUST DOWN Button
- 'AFM -> TYPE A' - Selected by pressing the ADJUST UP Button.

Press the SELECT UP button once. Leave the engine running.
Proceed to step 6

STEP 6 - LOAD AXIS Setup

This menu will display 'LOAD AXIS - TPS'. As described in the introduction, the load can be spanned using two options

- 'LOAD AXIS - TPS' - Selected by pressing the ADJUST UP Button and is recommended
- 'LOAD AXIS - CALC' - Selected by pressing the ADJUST DOWN Button.

The TPS is preferred as it requires minimal setup time and the Load Axis can be spanned with more accuracy and flexibility. There are 9 Rows available for tuning and the operator can select which of these rows are used. Proceed to the next STEP based on the following configuration:-

LOAD AXIS = TPS . Press SELECT UP once and go to STEP 7

LOAD AXIS = CALC and INTERCEPT = AFM. Press SELECT UP once and go to STEP 9

LOAD AXIS = CALC and INTERCEPT = MAP. The setup process is now complete Process to STEP 10.

STEP 7 - TPS Range Select

This menu will display 'L/A- 10 L/A+ 110'. This is the upper and lower limits the TPS will span on the Load Axis. These limits are adjustable using the following buttons:-

- The ADJUST Buttons allow the lower Load Axis limit to be changed ('L/A- xx'). This means when the TPS is fully closed it will point to 'xx' on the Load Axis
- The EDIT Buttons allow the upper Load Axis limit to be changed ('L/A+ yy'). This means when the TPS is fully open it will point to 'yy' on the Load Axis

For a normally aspired engine the TPS range is typically set between 10 & 110. For a turbo engine this can be increased to 10 & 240. This however is only a guide and it is up to the individual to decide on the number of rows required for tuning.

NOTE - The TPS Range can be changed at any time and does not require the user to enter the Setup Process.

The Intercept must now setup the factory TPS to span to rows specified during this step. To do this the closed and wide open throttle voltages must be read. Now Switch the engine off. Apply power to the intercept without starting the engine and scroll up to the menu described in this step. Press the SELECT UP button once and proceed to STEP 8

STEP 8 - TPS Calibration

This menu will display 'TPS (xx.xV) yy%' and allows the TPS span to be set. The TPS voltage is displayed in brackets and percentage throttle is displayed on right hand side of the screen. Closed throttle is scaled to indicate 0% and WOT (Wide Open Throttle) is scaled to read 100%.

Setting TPS Span:

- To set the span press and hold both edit buttons. The screen will show 'TPS - CLOSED zzz' At this point the throttle should be closed. 'z' represents the sampled TPS voltage
- After a 3 seconds delay the screen will display 'TPS - WOT zzz'. The throttle should now be fully depressed and left until the display returns to its normal menu (3 seconds).

A check should be performed to ensure the TPS span is set correctly. The display should read 0% with the throttle closed and approximately 100% with the throttle fully depressed. The setup process is now complete. Go to STEP 10

STEP 9 - LOAD AXIS Adjustment for AFM intercept

This menu will display 'Calibration Mode'. This mode allows the INTERCEPT to automatically adjust and calculate the Load Axis. To start this mode, press both EDIT buttons.

Step 9.1 - LOAD AXIS Range

The first menu will show 'NON TURBO' and will allow the engines breathing configuration to be selected. This will be used by the INTERCEPT to setup the Load Axis Range. The active setting is indicated by the flashing text.

- Non Turbo mode - The INTERCEPT will automatically adjust the Load Axis Range to lie between 20 -110. This allows 6 rows of zone tuning. Selected by using the ADJUST UP button.
- Turbo mode - The INTERCEPT will automatically adjust the Load Axis Range to lie between 20 - 240. This will allow 9 rows of tuning. Selected by using the ADJUST DOWN button.

Leave the engine running. Press the SELECT UP button once to proceed to step 9.2

Step 9.2 - LOAD AXIS Sampling

This menu displays 'WOT xxx O/R yyy' and will show Wide Open Throttle (WOT) and Overrun Vacuum (O/R) numbers. Both EDIT Buttons MUST now be pressed. This will reset both numbers to read approximately the same. The vehicle should now be taken for a short drive. The INTERCEPT will then be able to sample the engine allowing it to calculate the correct Load Axis.

Aim

While watching this menu the aim is to Minimise O/R and Maximise WOT numbers by driving the vehicle until these numbers stop changing. The size of these numbers is NOT important. This should only take one hard drive down the road.

- Maximum WOT will occur at low RPM, top gear, wot conditions
- Minimum O/R will occur at high RPM and closed throttle (overrun vacuum)

At any point both EDIT buttons can be pressed to reset the WOT and O/R numbers.

IMPORTANT NOTE: Revving the engine while the vehicle is stationary will give an incorrect representation of both the WOT and O/R numbers. For this setup to work correctly the vehicle **MUST** be driven under loaded conditions.

Once satisfied press the SELECT UP button once. Leave the engine running. Process to step 9.3

Step 9.3 - LOAD AXIS Calculation

The screen will show 'WOT xxx O/R yyy' At this point the INTERCEPT will automatically adjust Load Axis Range using the data gathered from the previous menu. The following criteria is used:

- O/R - Scaled to equal approximately 20
- WOT - Non turbo mode - Scaled to equal approximately 110
- WOT - Turbo mode - Scaled to equal approximately 240

The result will be displayed on this menu. Check both the WOT and O/R numbers to ensure the Load Axis range is as required. The WOT numbers may vary slightly depending on the voltage span of the AFM. To end the Calibration process, press the SELECT UP button. The menu will now return to the TEST RPM menu. The INTERCEPT is now configured and zone tuning can begin.

NOTE

The absolute accuracy of this scaling process is not critical, as it only determines the number of ROWS used in the Tuning process. It will not effect the engines final state of tune.

Proceed to STEP 10

STEP 10 - Setup Complete

The setup is now finished. Switch the engine off. Zone tuning can now begin.

4. TUNING MODULE FUNCTIONS

TEST RPM - Read Only

This is the default display and indicates engine RPM. This reading should be stable and in accordance with the factory tachometer.

CYLINDER SETTING

Displays the current number of cylinders. Changes are made by pressing the ADJUST buttons and must be stored and power recycled before the new settings become active.

LOAD AXIS

Displays the current Load Axis value of the engine and it will vary depending on how the Load Axis is being spanned. When using the factory TPS the rows available for tuning are fully adjustable. When calculating the Load Axis the tuning rows are fixed. The letter in brackets will indicate which parameter is used to span the Load Axis.

‘A’ = AFM

‘M’ = MAP

‘T’ = TPS

STORE

Used to store any corrections to memory. STORE is initiated by pressing BOTH ADJUST buttons together until the display shows “*****” and then releasing. The process will take from 2 to 30 seconds, depending on the number of corrections to be stored.

Code # =

Used to enter a code to unlock the adjustable functions of the InterceptLink. Use ADJUST to scroll the numbers. Use EDIT to move to the next number. STORE and turn the power off, then on. The InterceptLink is now unlocked and can be adjusted. For code setting refer to the “Set Code” section later in this chapter. If the code is not known the InterceptLink can be unlocked by entering RELOAD. Using RELOAD will reset all the numbers and settings back to the original Link ElectroSystems numbers and settings, tuning will be lost. Turn power off, then on.

RELOAD

This process will reset all zones to typical values to allow a base for subsequent tuning. Reload is activated by pressing both ADJUST buttons until the screen displays “*****” and then releasing.

CAUTION: RELOAD will over-write all values currently stored in the memory and should only be used during the initial setup or if you wish to restart the tuning procedure.

MASTER

The MASTER is used to provide overall scaling on the Air Flow Meter/MAP voltage before it is sent to the factory ECU and will effect the entire operating range from idle to full power. The adjustment range is from -128% through to +128%.

- 0% represents no overall change, so the Air Flow Meter/MAP Voltage is passed without scaling directly to ECU.
- Less than 0% = Adjusts the entire Air Flow Meter/MAP Voltage range to produce a leaner mixture.
- Greater than 0% = Adjusts the entire Air Flow Meter/MAP Voltage range to produce a richer mixture.

The MASTER is adjusted by pressing the ADJUST buttons. A MASTER change of + 1 % will cause the AFM/MAP voltage to be scaled by approximately 8mV. The maximum voltage that can be added to the AFM/MAP signal is therefore 1 Volt (128*8mV) and when this limit is reached the symbol '>' will be displayed.

The minimum voltage that can be subtracted from the AFM/MAP signal is 1 Volt and the symbol '<' will be displayed to show when this limit is reached.

ZN ADJ

There are 144 small fuel zones arranged in a rectangular grid of 9 ROWS by 16 COLUMNS. The ROWS are formed using engine load and the COLUMNS progress in steps of RPM. Each zone therefore represents a unique engine operating condition, allowing fuel changes to be made in small, localised areas. The zone selection is automatic with the current zone displayed in the centre of the screen and its associated value to the right, represented as a percentage. Adjustments are made by operating the ADJUST buttons as required. Values range from -128% - +128%.

0% -Allows the sampled AFM/MAP voltage to be returned to the factory ECU without scaling. This is the default number stored during a RELOAD. An increase in this number will richen the mixture, while a decrease will produce a leaner mixture. All zones use interpolation.

As changes are made, the AFM & ECU voltages can be viewed from the VOLTAGE Menu.

LGE ZN Z=x

The zone table has been divided into 24 large zones. The zone selection is automatic with the current zone (x) displayed in the centre of the screen and its associated value to the right, represented as a percentage. Adjustments are made by operating the ADJUST buttons as required. Values range from -128% - +128%. All zones use interpolation.

0% -Allows the sampled AFM/MAP voltage to be returned to the factory ECU without scaling. This is the default number stored during a RELOAD. An increase in this number will richen the mixture over the entire Large Zone 'x', while a decrease will produce a leaner mixture.

NOTE - Even though the large zones overlap the smaller ones, they all operate independently. For example, entering a number into large Zone 0 will not alter any of the numbers in small Zones 100, 105, 200, 205. The purpose of the large zone structure is to allow the user a coarse and hence quick approach to zone tuning

VOLTAGE (Read Only)

Used to monitor two important voltages and will reflect the INTERCEPTS Mode.

Intercept = AFM

AFM = Air Flow Meter Voltage

VECU = Voltage sent to factory ECU after scaling

When the AFM is not connected, 'Offline' will replace 'AFM' indicating a problem.

Intercept = MAP

MAP = MAP Sensor Voltage (MAP Mode)

VECU = Voltage sent to factory ECU after scaling

EDIT

Enables the zone editor function, which allows access to all 184 zones for viewing and editing. These include both large and small zones. The EDIT function may be used at any time, with or without the engine running. Use the EDIT push buttons to select the appropriate zone(s) and ADJUST buttons to change the selected zone. The zone is identified by a number displayed in the centre of the screen. Storing of edited values may be done by pressing BOTH

EDIT buttons together until the display shows “*****” and then releasing. Alternatively, STORE may be selected.

SYS VOLTS (Read Only)

Displays the operating voltage of the vehicle.

INTERCEPT MODE

This allows the INTERCEPTS Mode to be configured for either AFM or MAP.

AFM Mode : - Used for Intercepting the AFM Signal - ADJUST UP Button

MAP Mode : - Used for Intercepting a MAP Sensor Signal - ADJUST DOWN Button

NOTE - Using the ADJUST button will automatically save the configuration.

AFM TYPE

This menu will only be displayed when intercepting the AFM, allowing the AFM Type to be selected.

For instructions on testing the AFM Type see section 3, Step 3.

TYPE A: ADJUST UP

TYPE B: ADJUST DOWN

Type A AFM: Voltage at idle <(less than) Voltage at WOT.

Type B AFM: Voltage at idle >(greater than) Voltage at WOT.

LOAD AXIS

From this menu the parameter used to span the Load Axis can be selected. The two options are

TPS (recommended)- Press ADJUST UP

Calculation - Press ADJUST DOWN

TPS RANGE SELECT

This menu allows the operator to adjust the upper and lower limits that the TPS will span on the Load Axis. These limits are adjustable using the following buttons:-

- The ADJUST Buttons allow the lower Load Axis limit to be changed ('L/A- xx'). This means when the TPS is fully closed it will point to 'xx' on the Load Axis
- The EDIT Buttons allow the upper Load Axis limit to be changed ('L/A+ yy'). This means when the TPS is fully open it will point to 'yy' on the Load Axis

Set Code

Used by the installer to set the lockout code. Setting the code should avoid tampering by others and protect the numbers entered. To set the code the InterceptLink must be unlocked (all functions visible). Enter your code and press STORE. Turn power off, then on. The InterceptLink is now locked.

TPS MENU

This menu allows the TPS span to be set. The TPS voltage is displayed in brackets and percentage throttle is displayed on right hand side of the screen. Closed throttle is scaled to indicate 0% and WOT scaled to read 100%.

Setting TPS Span:

- To set the span press and hold both edit buttons. The screen will show 'TPS - CLOSED ' At this point the throttle should be closed.
- After a 3 seconds delay the screen will display 'TPS - WOT '. The throttle should now be fully depressed and left until the display returns to its normal menu.

A check should be performed to ensure the TPS span is set correctly. The display should read 0% with the throttle closed and approximately 100% with the throttle fully depressed.

Calibration Mode

Allows the INTERCEPT to automatically setup the Load Axis when scaling an AFM signal. This mode will only be used when the TPS is not available and the AFM is required to span the Load Axis. To start press and hold both EDIT buttons.

5. TUNING PROCEDURE

It is assumed at this point that the INTERCEPT has been configured as required using the Calibration Process and tuning is ready to begin. All tuning menus which include MASTER, ZN AFM and ZN ADJ are initially reset to 0% which means the voltage produce by the AFM/MAP sensor is passed directly without scaling to the factory ECU. This can be observed on the Tuning Module, by scrolling to the VOLTAGE menu and noting that both readings are the same.

Mixture Adjustment

Tuning is now a simple procedure. An increase in the MASTER will richen the mixture over the entire operating range of the engine while a decrease will produce a leaner mixture. If a particular load condition requires a mixture change, simply go to the correct zone and adjust. This can either be done in ZN ADJ allowing the engines current operating zone to be adjusted, or by using LGE ZM and adjusting the engines current large zone, or by using the Zone Editor. As adjustments are made the VOLTAGE menu can be used to observe the changes in the AFM/MAP and ECU voltages. REMEMBER to save any changes by using the STORE menu.

6. TUNING PORT

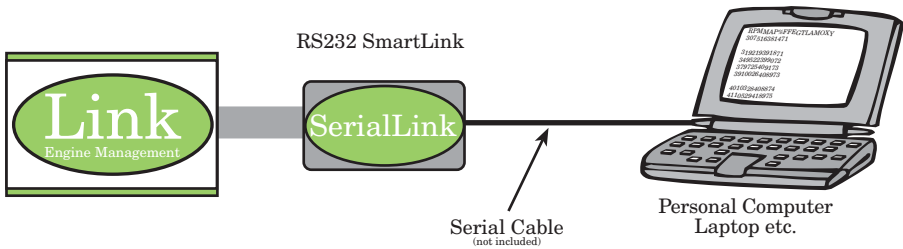
The fourteen pin connector located at one corner of the circuit board allows connection of various tuning and diagnostic tools to the system. All devices use a fourteen line flat ribbon cable, and connectors are keyed to prevent incorrect installation. The following devices are currently available.

Link Tuning Module

The Link Tuning module allows all aspects of fuel and utility functions to be adjusted, edited and stored. Detailed instructions are included elsewhere in this manual.

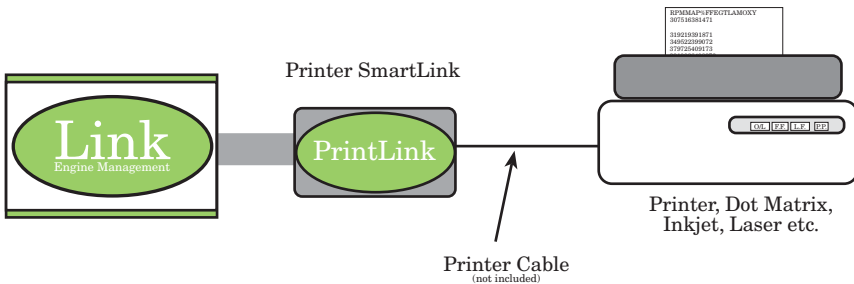


SerialLink



The SerialLink allows communication between the InterceptLink and a personal computer via the PC's RS232 serial port for data-logging and downloading of the InterceptLink settings. While the engine is running a stream is sent to the PC showing engine parameters such as RPM, TPS and input/output MAP/AFM voltages. The information may be recorded using the PC's memory disk drive. Graphs etc. may be created using spreadsheets etc.

PrintLink



The PrintLink is similar to the SerialLink above except that the PrintLink connects directly to any type of printer for instant hard copy data. An alternative option is to use a battery backed "printer buffer" to store information while test driving and then downloading the buffer to a printer. Typical buffers allow in excess of one hours logging time.

Master	CY	AFM	Align	Span	Mode
0	1	2	3	4	5

Settings

0	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	
20	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175
40	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275
60	300	305	310	315	320	325	330	335	340	345	350	355	360	365	370	375
80	400	405	410	415	420	425	430	435	440	445	450	455	460	465	470	475
100	500	505	510	515	520	525	530	535	540	545	550	555	560	565	570	575
120	600	605	610	615	620	625	630	635	640	645	650	655	660	665	670	675
160	700	705	710	715	720	725	730	735	740	745	750	755	760	765	770	775
200	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875
240	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970	975

InterceptLink Zone Sheet

0	4	8	12	16	20
1	5	9	13	17	21
2	6	10	14	18	22
3	7	11	15	19	23

Large Zones

