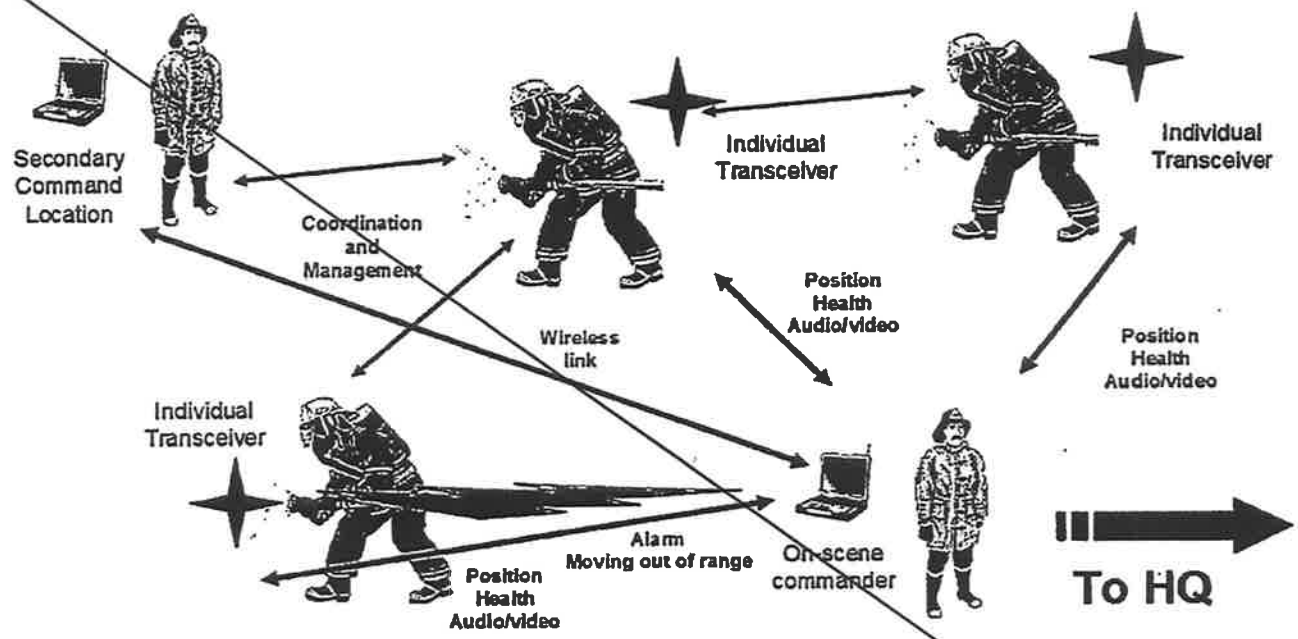

Secondary
Command
Location
Coordination
and
Management
Individual
Transceiver
Individual
Transceiver
Position
Health
Audio/video
Wireless
link
Position
Health
Audio/video
Individual
Transceiver
Alarm
Moving out of range
Position
Health
Audio/video
On-scene
commander
To HQ

Figure 1.

Figure 2

Figure 3

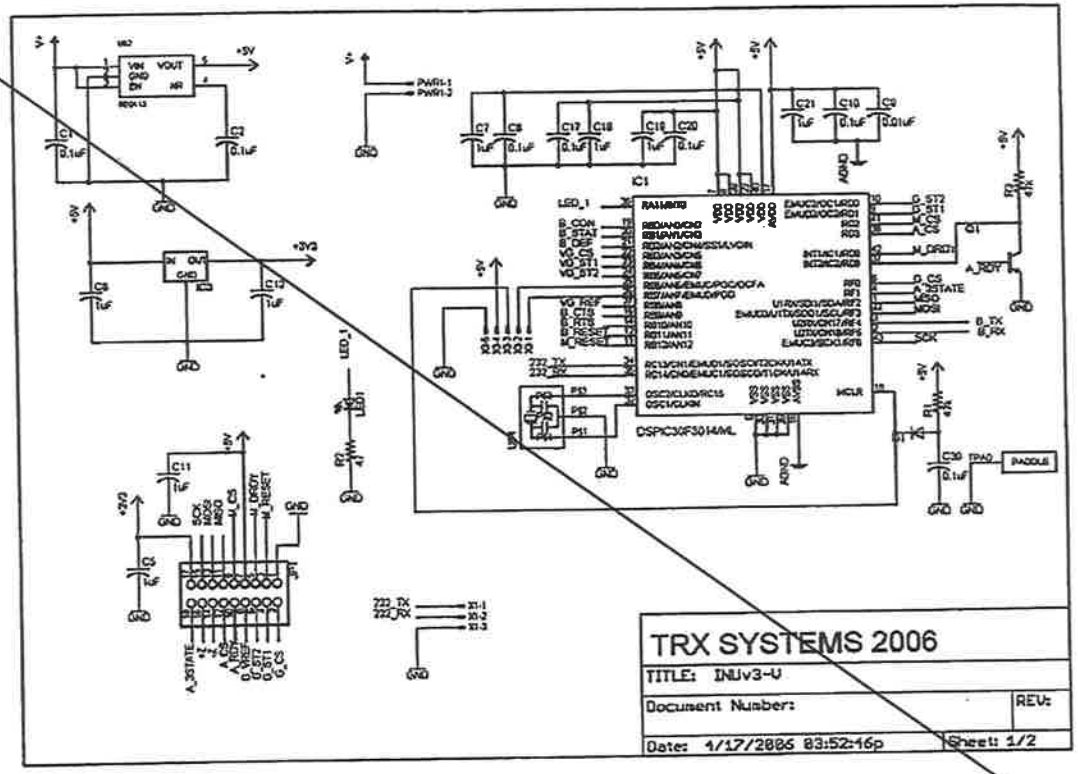


Figure 4: Schematic 1 Vertical INU Section A

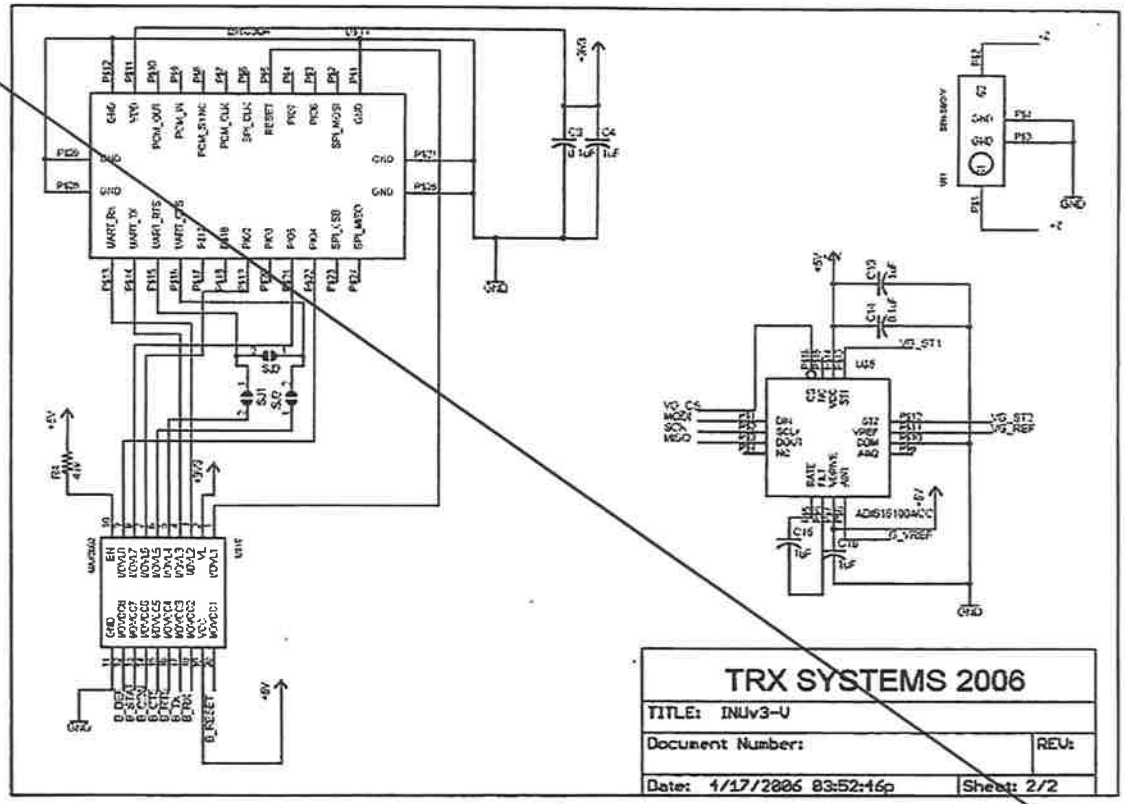


Figure 5: Schematic 2, Vertical INU Part B

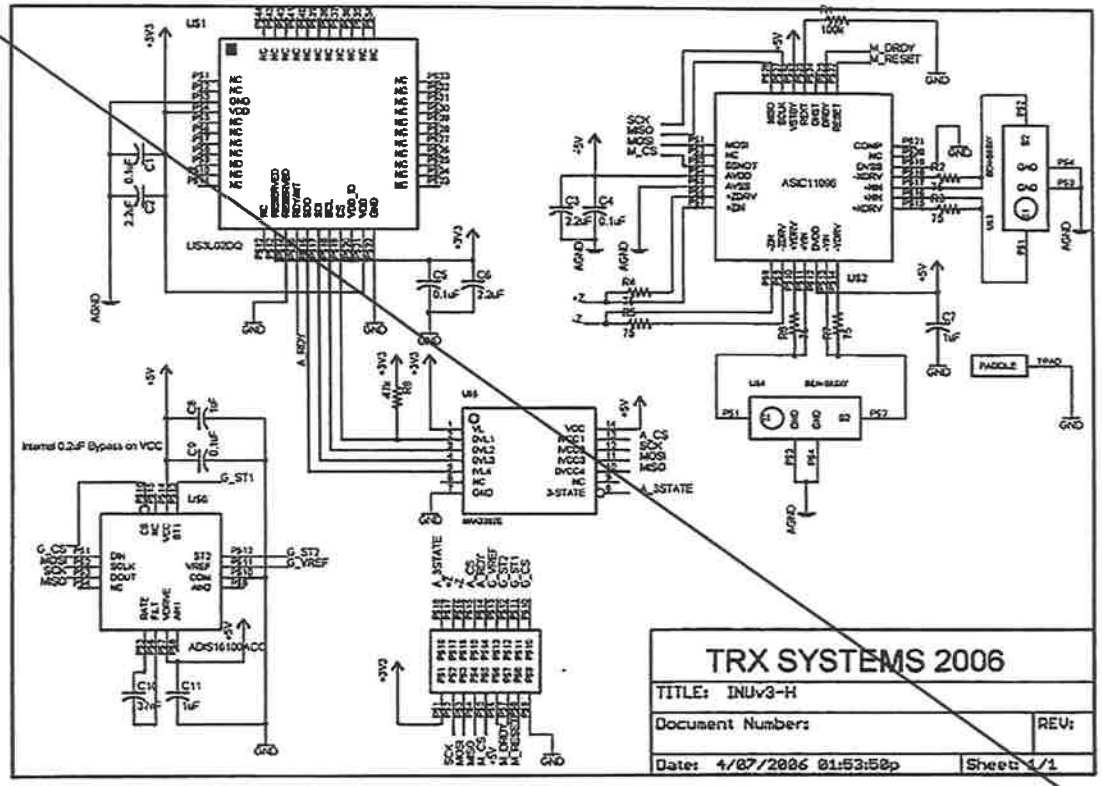


Figure 6: Schematic3, Horizontal INU

Figure 7

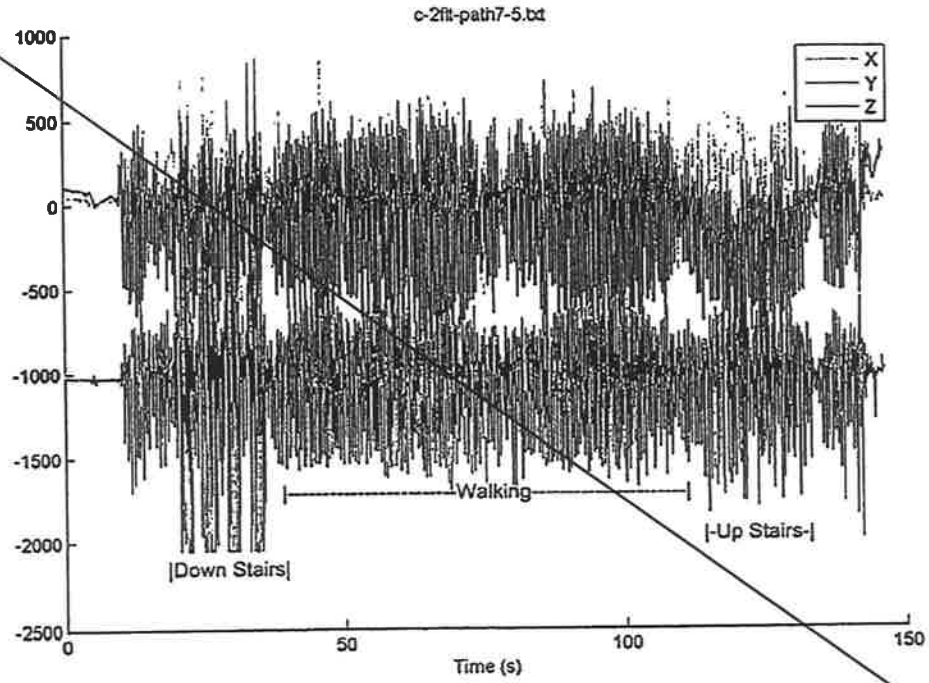

c-2fit-path7-5.txt
X
Y
Z
1000
500
0
-500
-1000
-1500
-2000
-2500
0
50
100
150
Time (s)
|Down Stairs|
Walking
|-Up Stairs-|

Figure 8.

θcompass
e
Ks
STOPPED
1/[1+abs(1-|H|)]
1/[1+var(|H|)]
1/[1+var(|e|)]
K
MOVING
θout
z-1
dθgyro

Figure 9

Figure 10

Figure 11

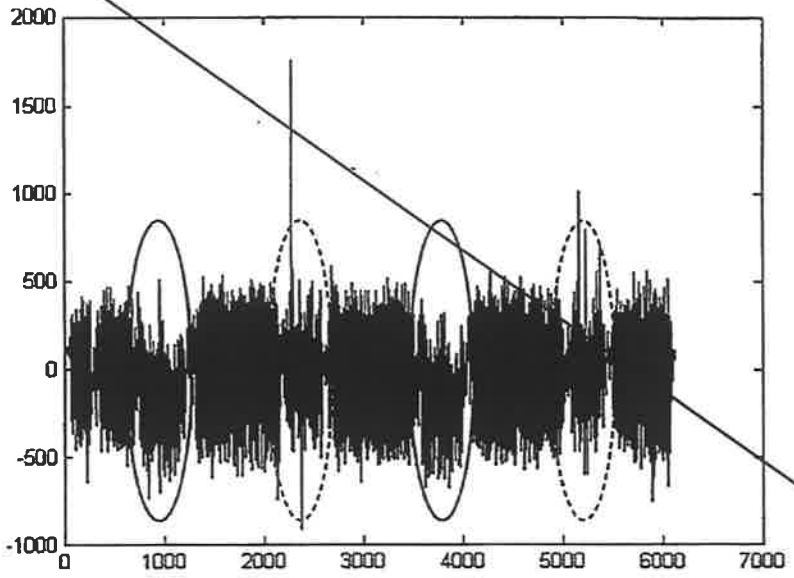

2000
1500
1000
500
0
-500
-1000
0
1000
2000
3000
4000
5000
6000
7000

Figure 12

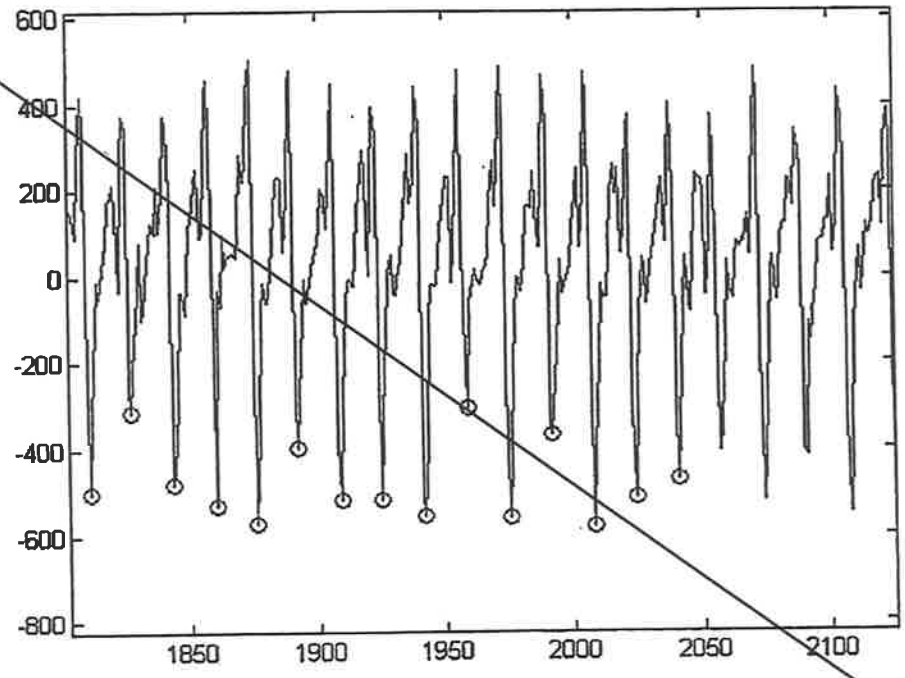


Figure 13

Figure 14

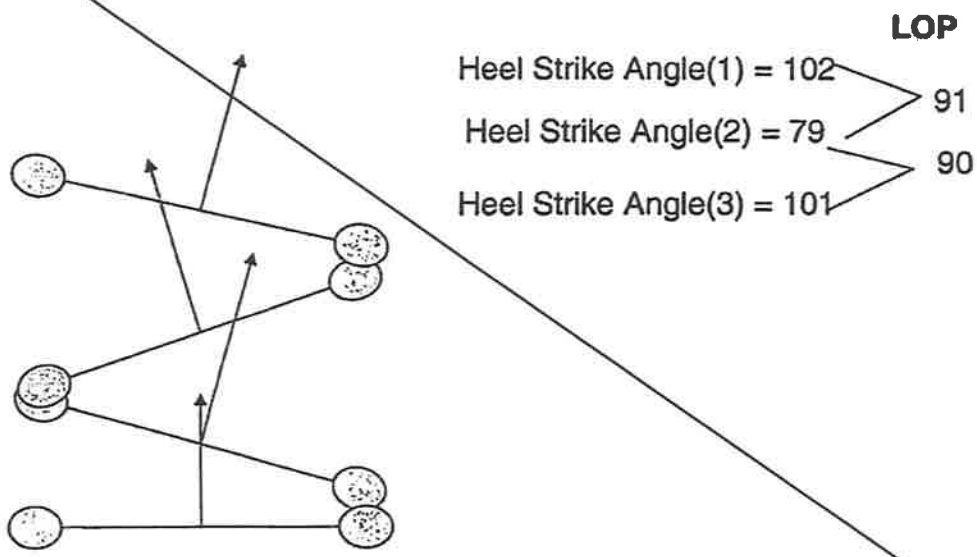

LOP
Heel Strike Angle(1) = 102
Heel Strike Angle(2) = 79
Heel Strike Angle(3) = 101
91
90

Figure 15

Figure 17

Figure 16

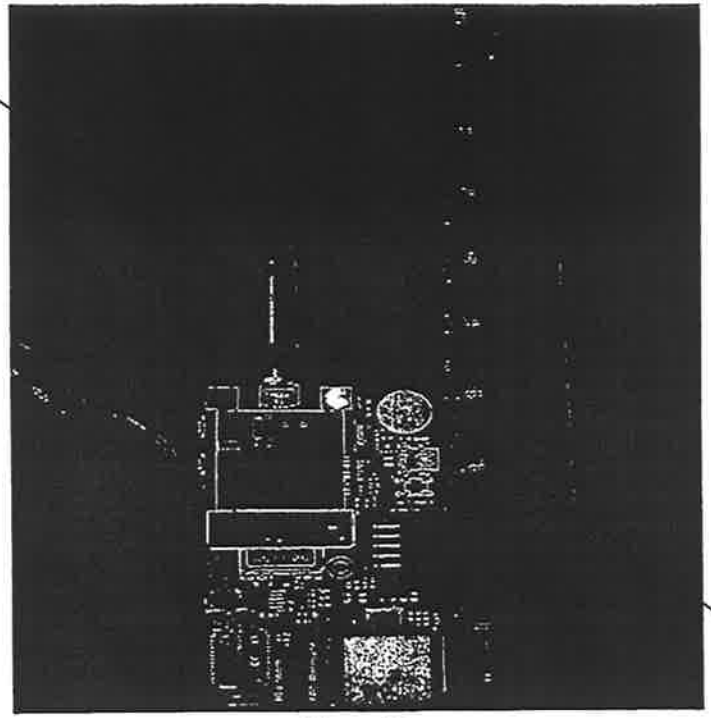


Figure 18

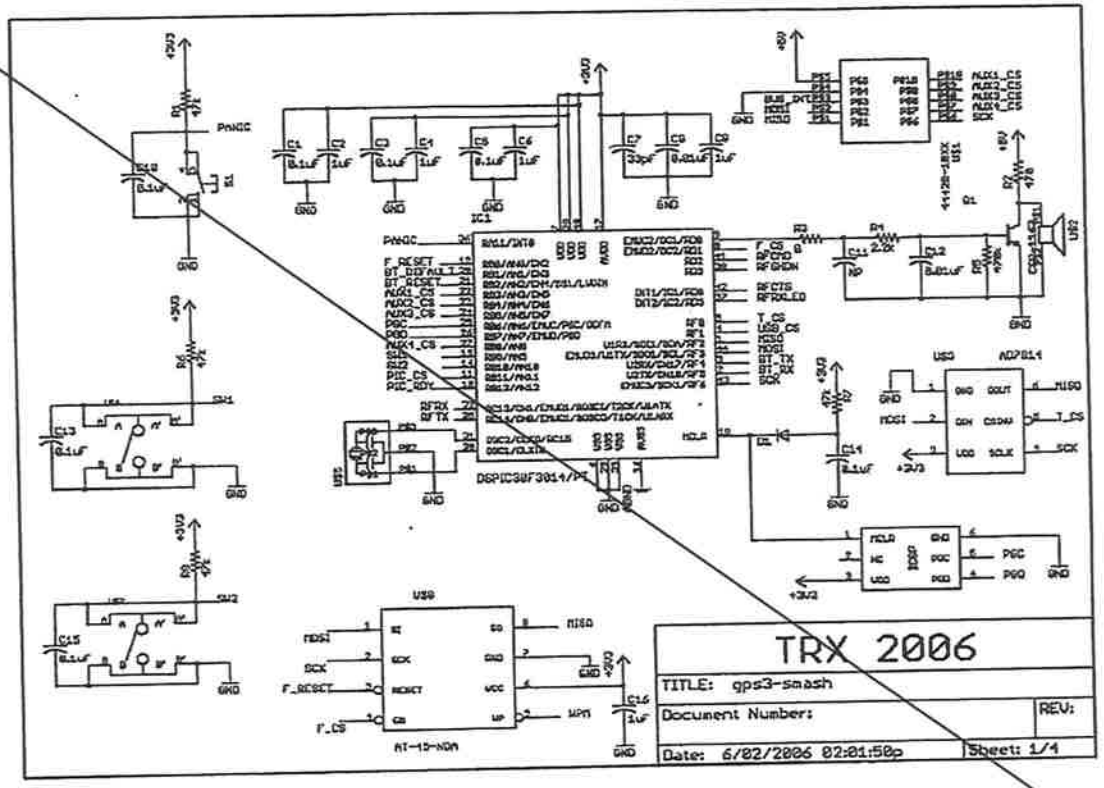


Figure 19: Communications and Sensor Motherboard Schematic 1

Figure 20: Communications and Sensor Motherboard Schematic 2

Figure 21: Communications and Sensor Motherboard Schematic 3

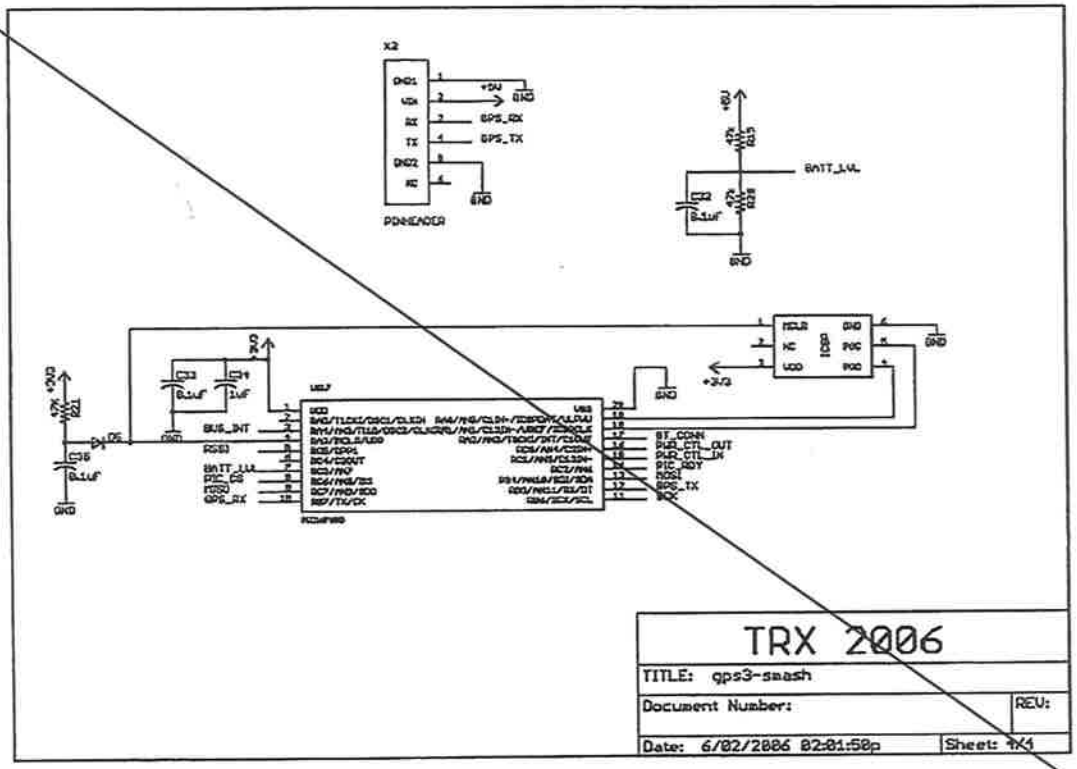


Figure 22: Communications and Sensor Motherboard Schematic 4

Figure 23

Figure 24

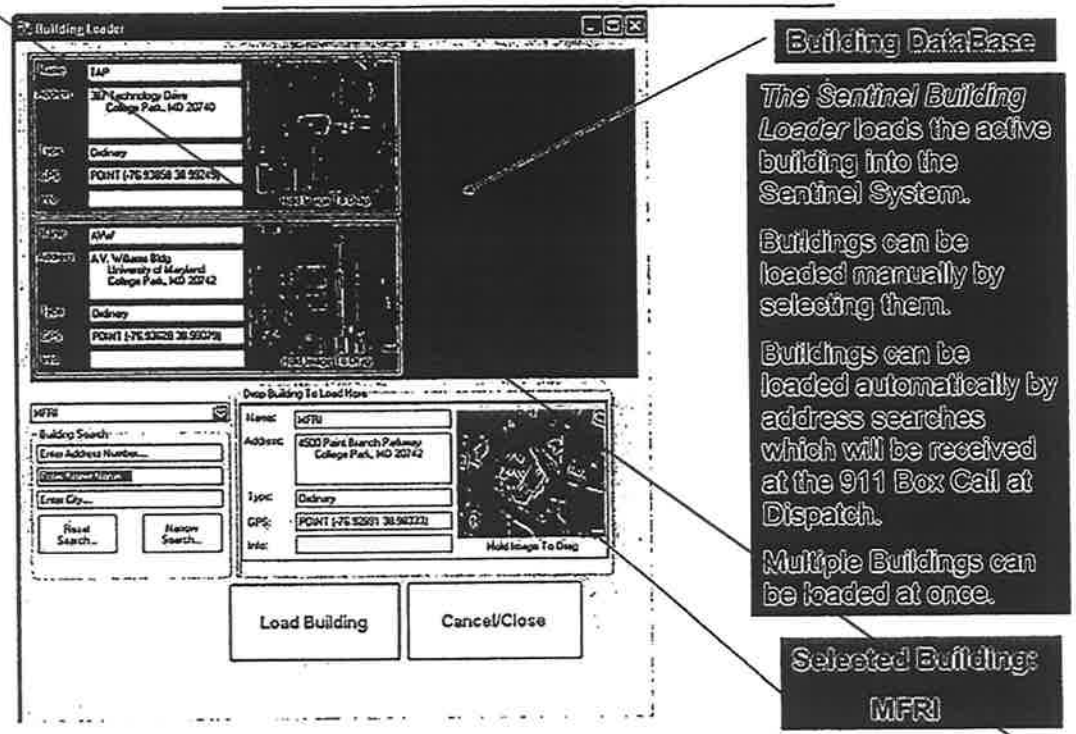
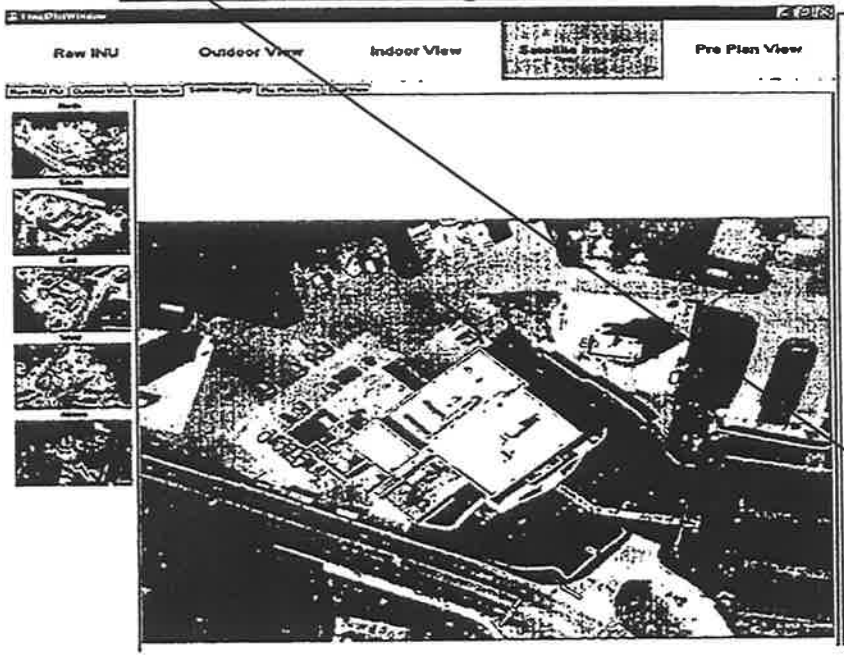

Building Loader
Load Building
Cancel/Close
Building DataBase
The Sentinel Building Loader loads the active building into the Sentinel System.
Buildings can be loaded manually by selecting them.
Buildings can be loaded automatically by address searches which will be received at the 911 Box Call at Dispatch.
Multiple Buildings can be loaded at once.
Selected Buildings:
MFRI

Figure 25

Sentinel System Satellite Views



The SATTELITE IMAGERY tab allows the Incident Commanders and firefighters to plan the mission on the way to the incident scene and at the scene.

It provides geographic and structural awareness of the surrounding area.

TOP VIEW: The top view reveals critical roof information for Roof and Venting operations.

N,S,E, W views provide side views of the building revealing window, exit and other structural information.

From: *Microsoft Live Locals*

Figure 26

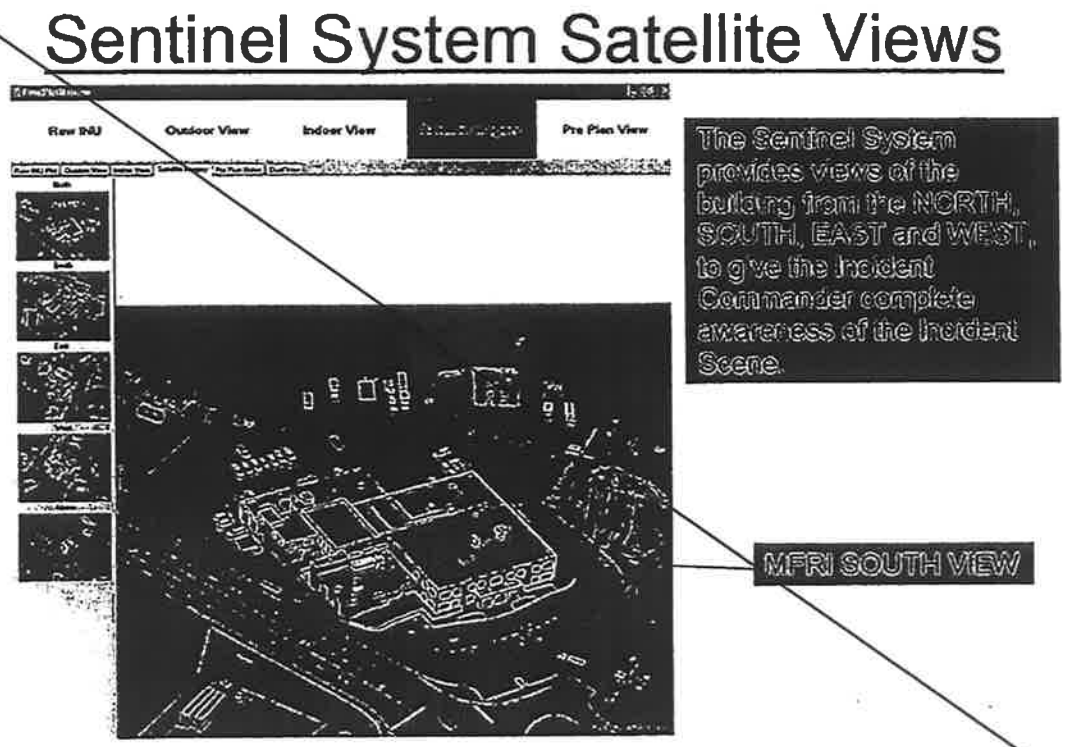

Sentinel System Satellite Views
Raw INU
Outdoor View
Indoor View
Pre Plan View
The Sentinel System provides views of the building from the NORTH, SOUTH, EAST and WEST, to give the Incident Commander complete awareness of the Incident Scene.
MFRI SOUTH VIEW

Figure 27

SENTINEL PREPLAN VIEW

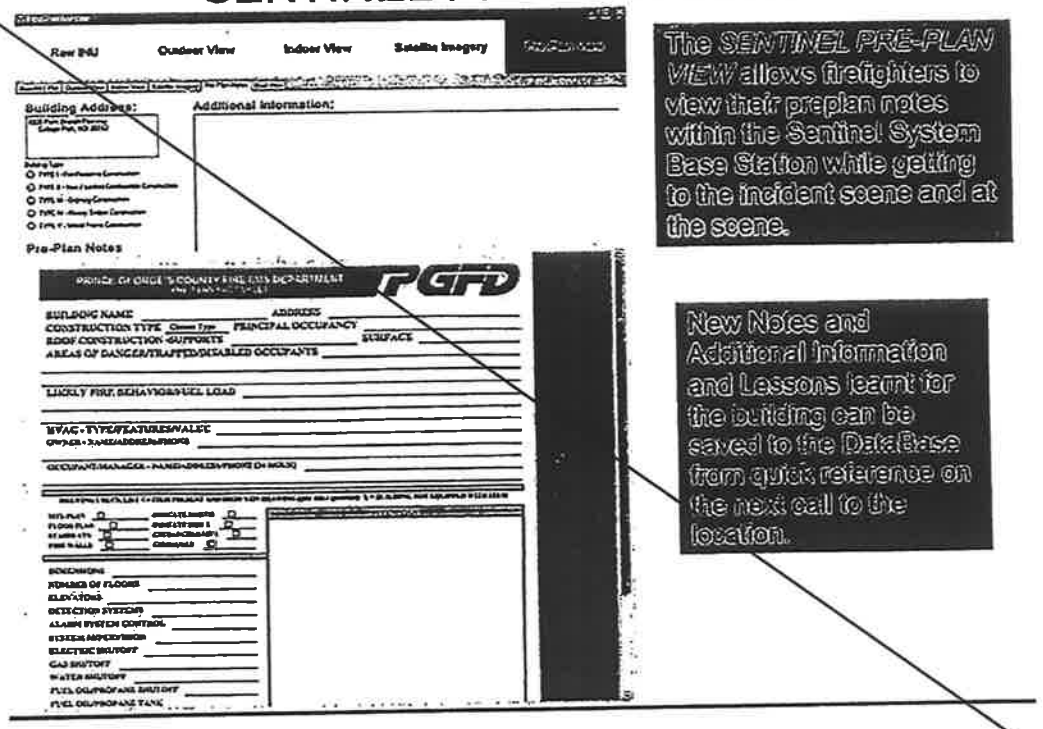


Figure 28

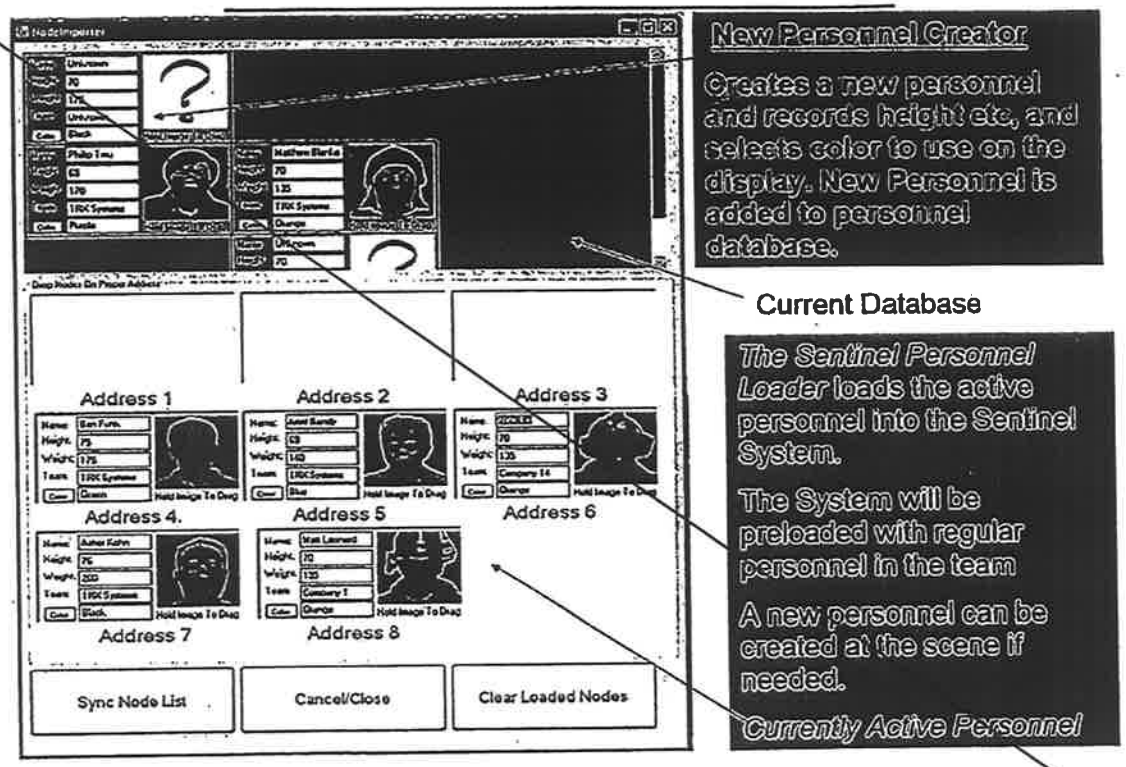

New Personnel Creator
Creates a new personnel and records height etc, and selects color to use on the display. New Personnel is added to personnel database.
Current Database
The Sentinel Personnel Loader loads the active personnel into the Sentinel System.
The System will be preloaded with regular personnel in the team
A new personnel can be created at the scene if needed.
Currently Active Personnel
Address 1
Address 2
Address 3
Address 4.
Address 5
Address 6
Address 7
Address 8
Sync Node List
Cancel/Close
Clear Loaded Nodes

Figure 29

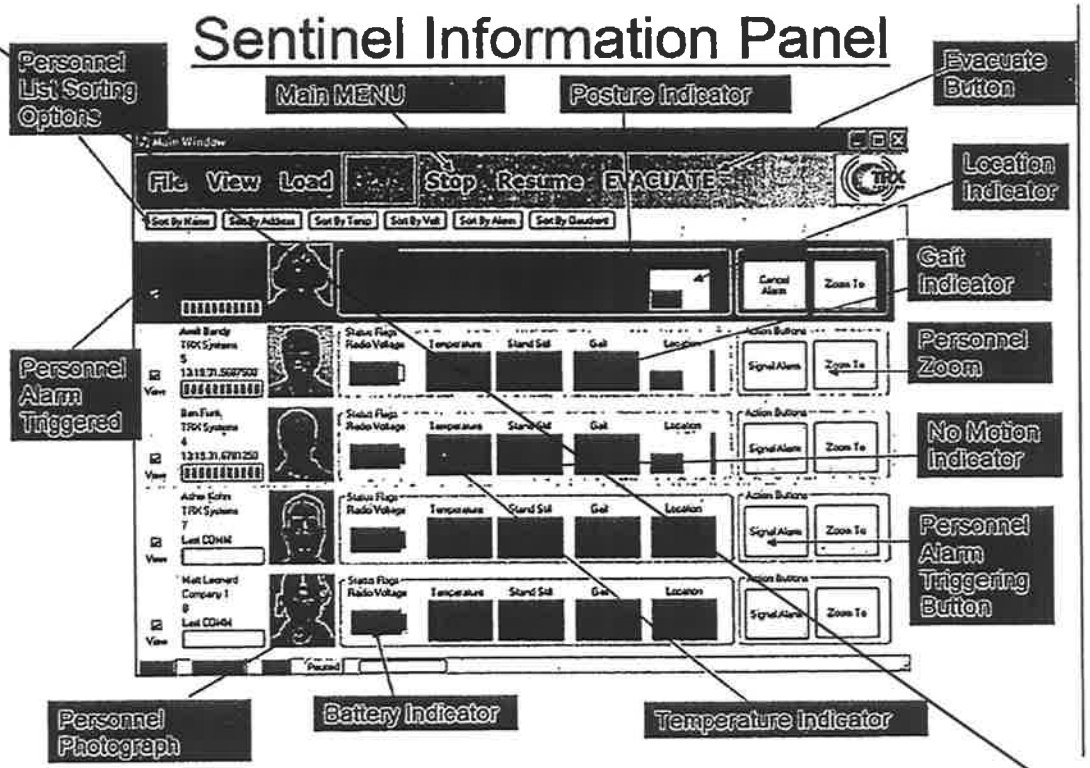
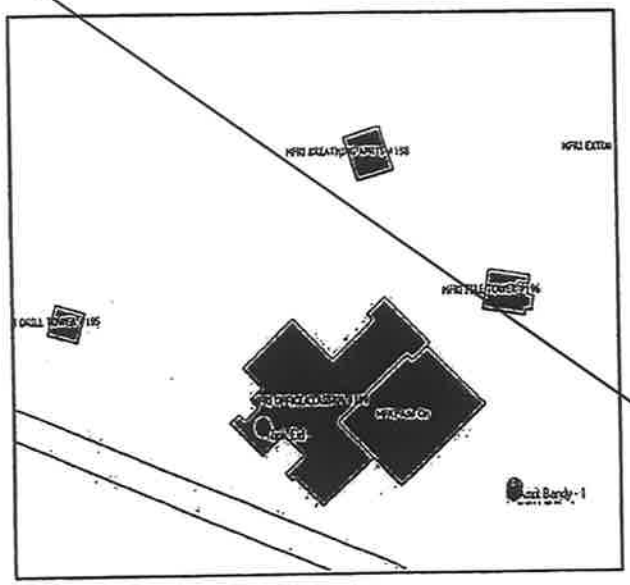

Sentinel Information Panel
Personnel List Sorting Options
Main MENU
Posture Indicator
Evacuate Button
Location Indicator
Gait Indicator
Personnel Zoom
No Motion Indicator
Personnel Alarm Triggering Button
Personnel Alarm Triggered
Personnel Photograph
Battery Indicator
Temperature Indicator
File View Load
Stop Resume EVACUATE

Figure 30

SENTINEL OUTDOOR TRACKING VIEW



The Outdoor tracking locations are displayed on a GIS Map of the scene. The Outdoor plot automatically zooms to the loaded incident scene.

The GIS view has been chosen as a result of

- Simplicity of View
- Fewer Colors than satellite imagery
- Standard representation

Figure shows personnel in 'red' *(Nick Ed)* triggering his alarm indoors, while Rescue Team of two is located outdoors at MFR1.

Figure 31

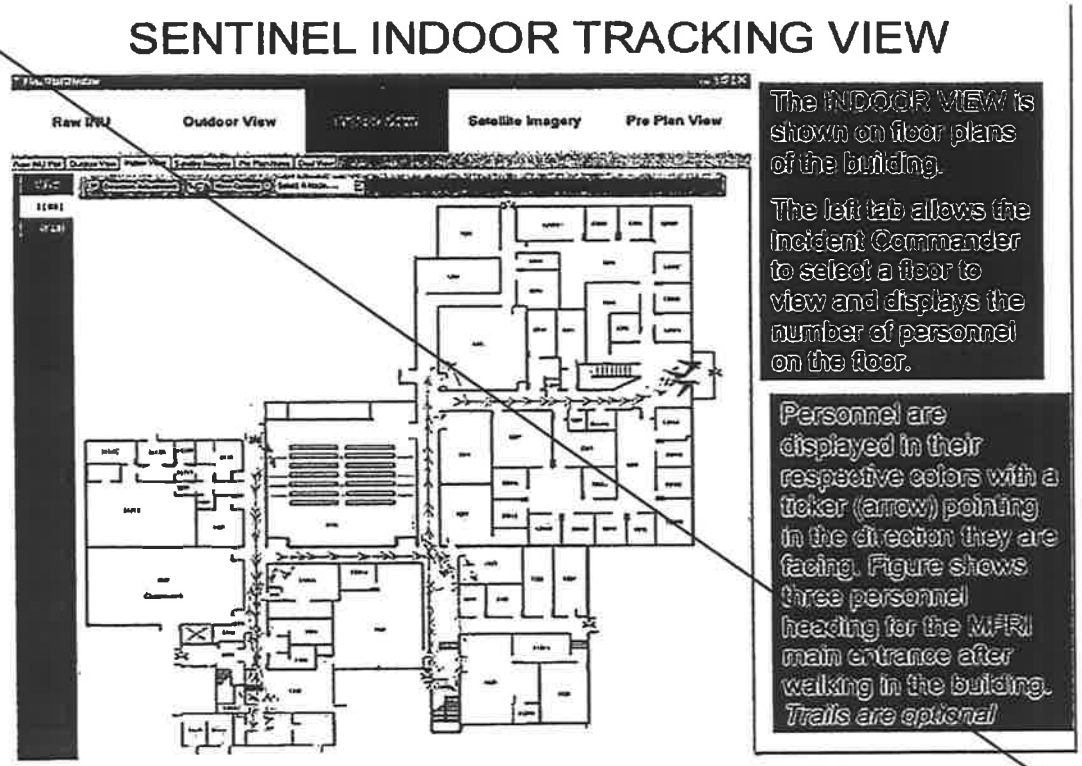

SENTINEL INDOOR TRACKING VIEW
Raw IMU
Outdoor View
Satellite Imagery
Pre Plan View
The INDOOR VIEW is shown on floor plans of the building.
The left tab allows the Incident Commander to select a floor to view and displays the number of personnel on the floor.
Personnel are displayed in their respective colors with a ticker (arrow) pointing in the direction they are facing. Figure shows three personnel heading for the MFR main entrance after walking in the building. Trails are optional

Figure 32

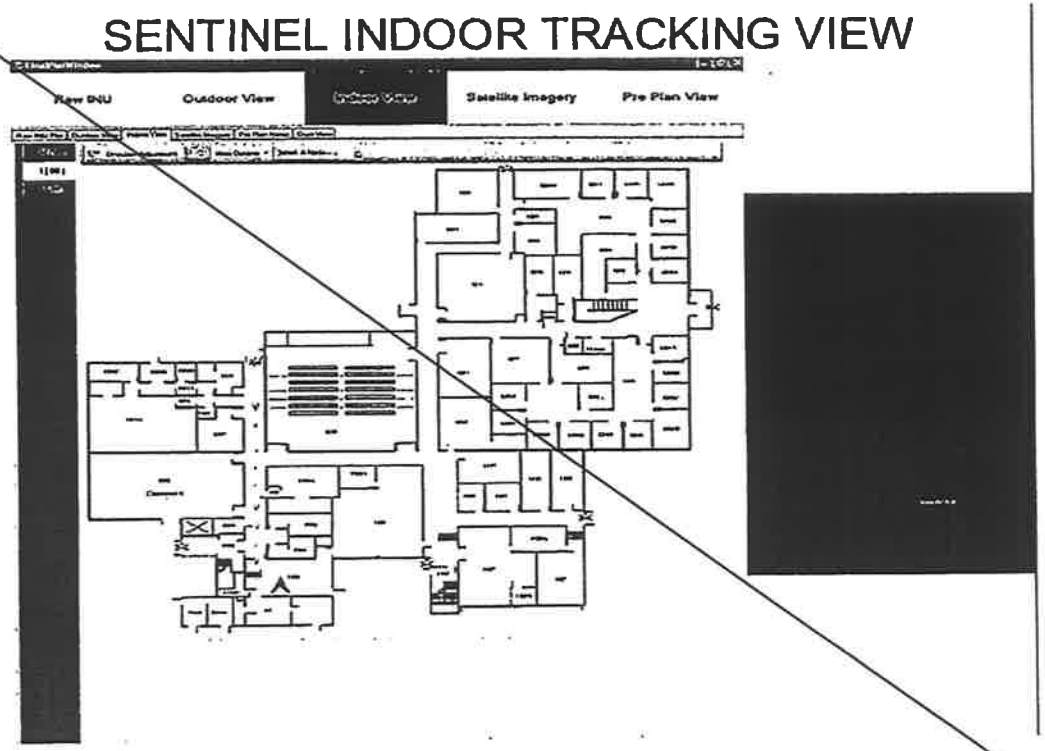

SENTINEL INDOOR TRACKING VIEW
Raw DNU
Outdoor View
Satellite Imagery
Pre Plan View

Figure 33

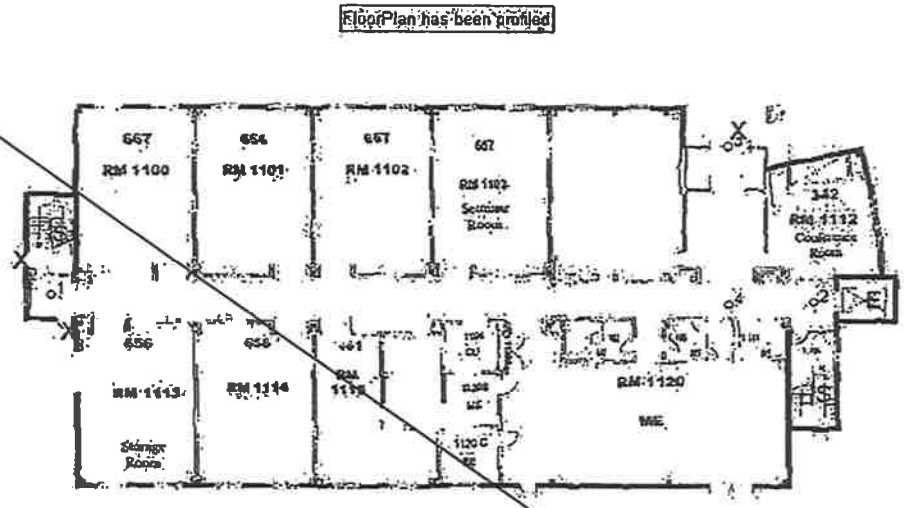

FloorPlan has been profiled
667
RM 1100
654
RM 1101
667
RM 1102
667
RM 1103
Seminar Room
342
RM 1112
Conference Room
656
RM 1113
Storage Room
656
RM 1114
RM 1115
RM 1120
ME

Figure 34

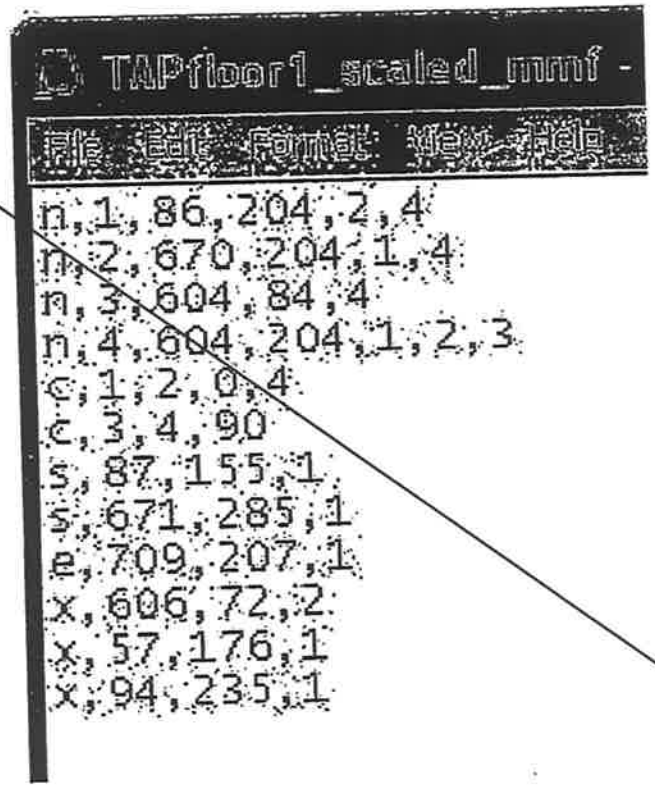
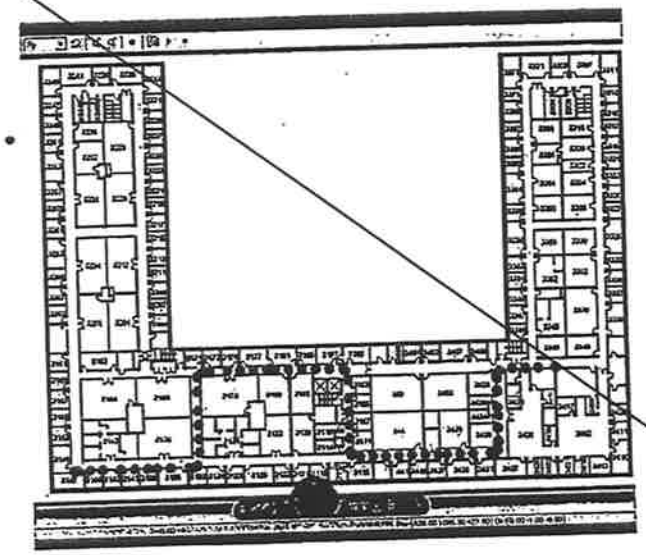

TAPfloor1_scaled_mmf -
File Edit Format View Help
n,1,86,204,2,4
n,2,670,204,1,4
n,3,604,84,4
n,4,604,204,1,2,3
c,1,2,0,4
c,3,4,90
s,87,155,1
s,671,285,1
e,709,207,1
x,606,72,2
x,57,176,1
x,94,235,1

Figure 35

Figure 36

Figure 37



Figures 38

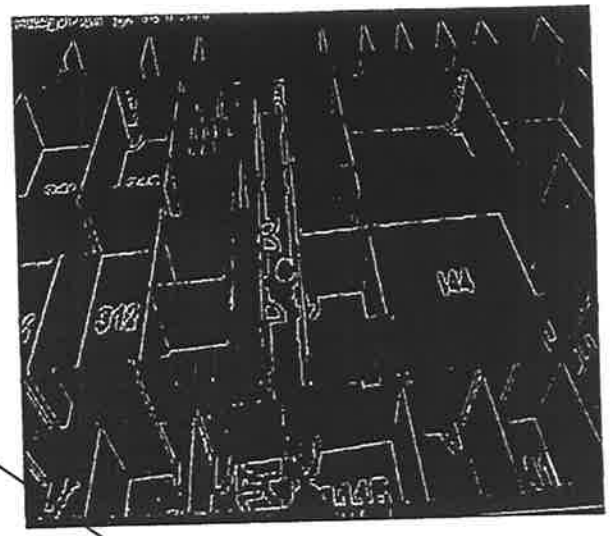


Figure 39

Figure 40

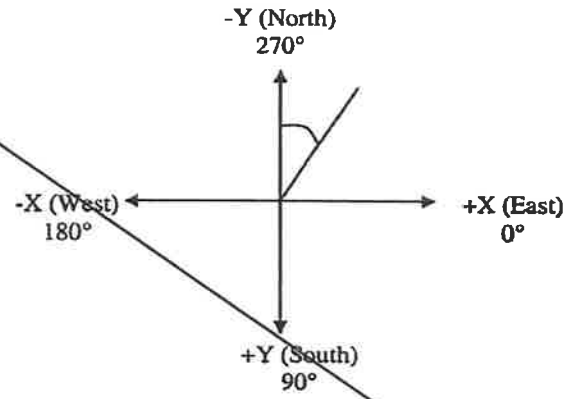


Figure 41

Figure 42

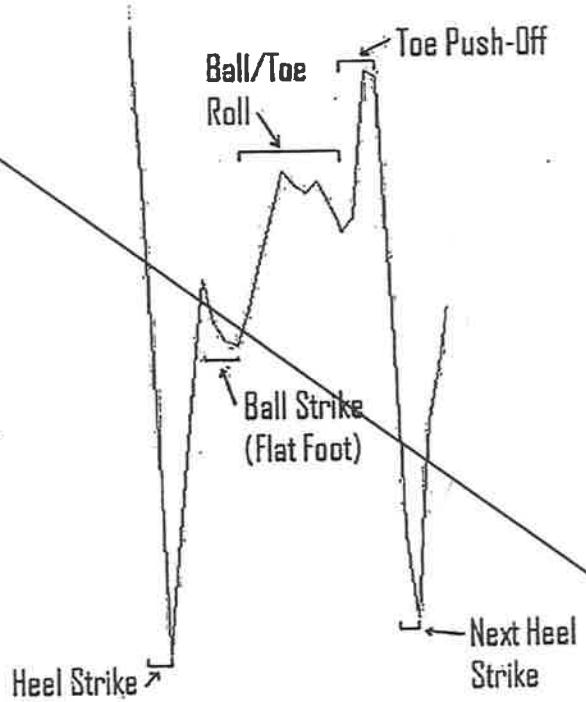

Toe Push-Off
Ball/Toe
Roll
Ball Strike
(Flat Foot)
Next Heel
Strike
Heel Strike

Figure 43

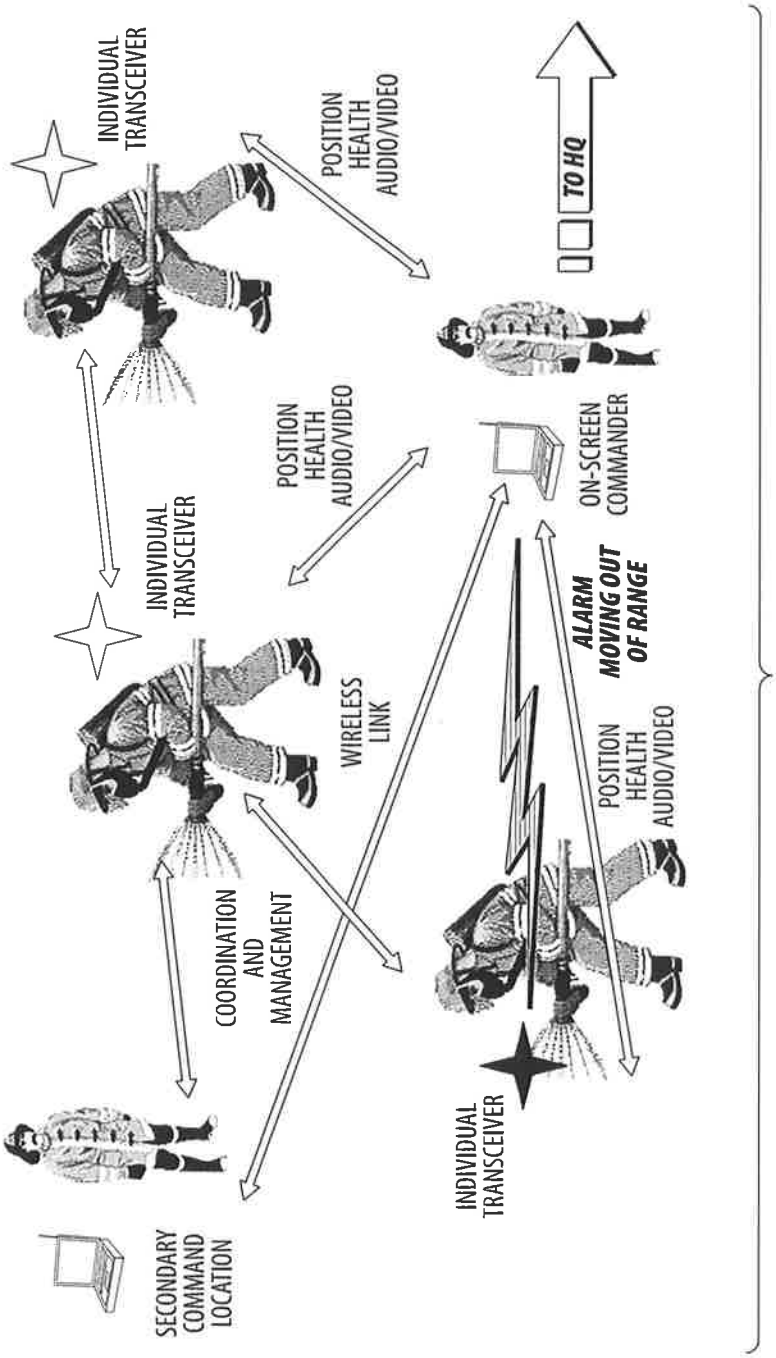

INDIVIDUAL TRANSCEIVER
POSITION HEALTH AUDIO/VIDEO
TO HQ
POSITION HEALTH AUDIO/VIDEO
ON-SCREEN COMMANDER
INDIVIDUAL TRANSCEIVER
WIRELESS LINK
ALARM MOVING OUT OF RANGE
POSITION HEALTH AUDIO/VIDEO
COORDINATION AND MANAGEMENT
INDIVIDUAL TRANSCEIVER
SECONDARY COMMAND LOCATION

Fig. 1



Fig. 2

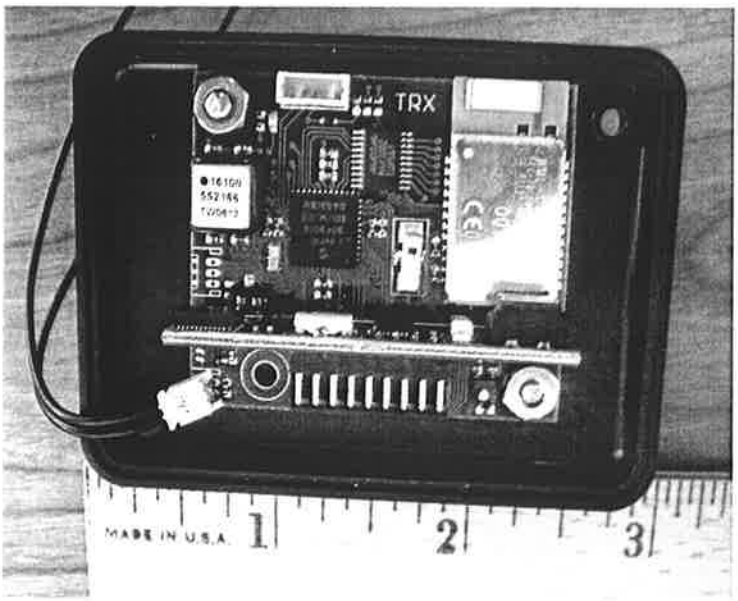


Fig. 3

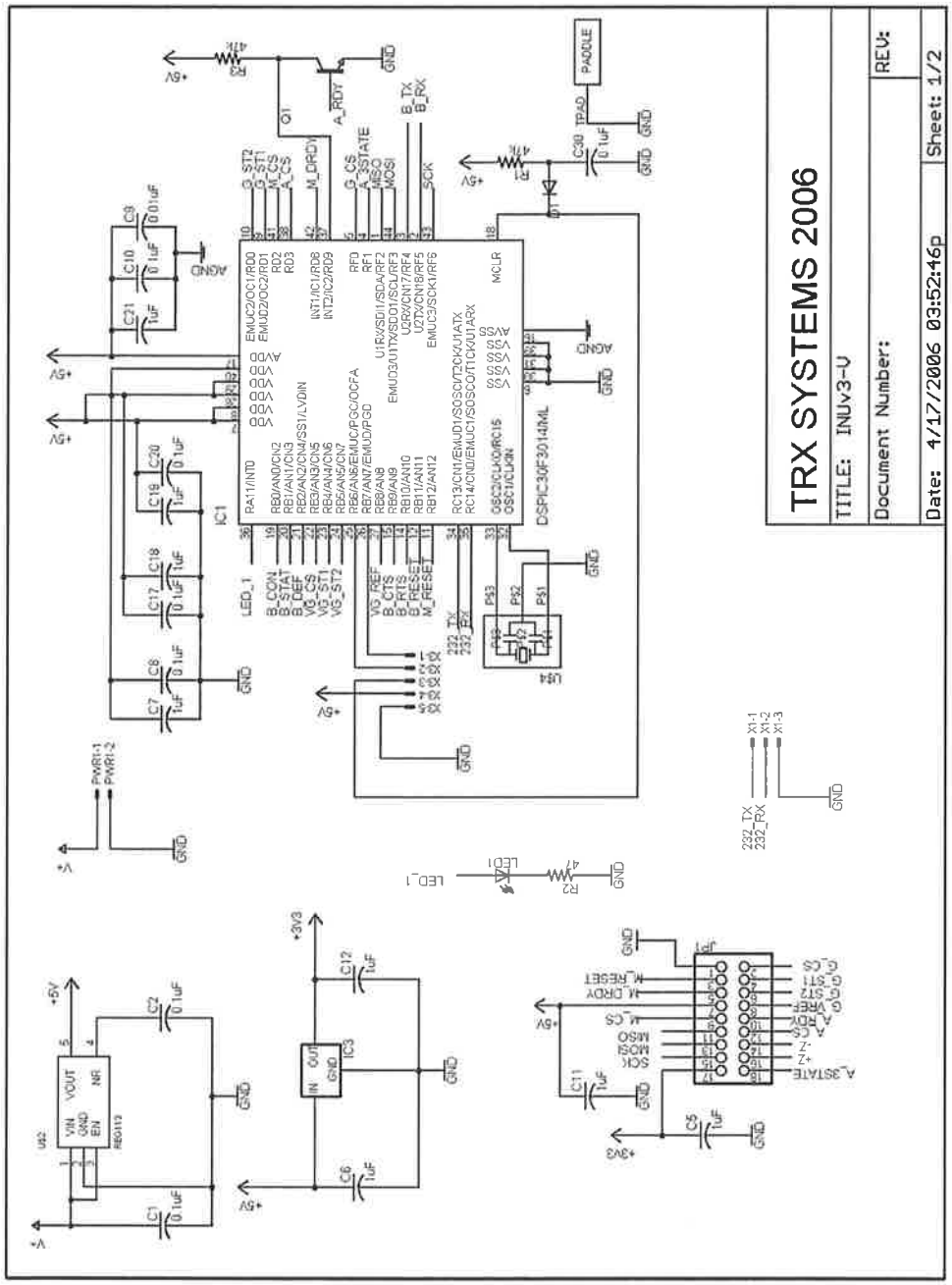

TRX SYSTEMS 2006
TITLE: INUv3-U
Document Number:
REV:
Date: 4/17/2006 03:52:46p
Sheet: 1/2
DSPIC30F3014ML
PADDLE
A_RDY
B_TX
B_RX
G_CS
A_3STATE
MISO
MOSI
SCK
M_DRDY
M_RESET
M_CS
232_TX
232_RX
LED_1
+5V
+3V3
AGND
GND

Fig. 4

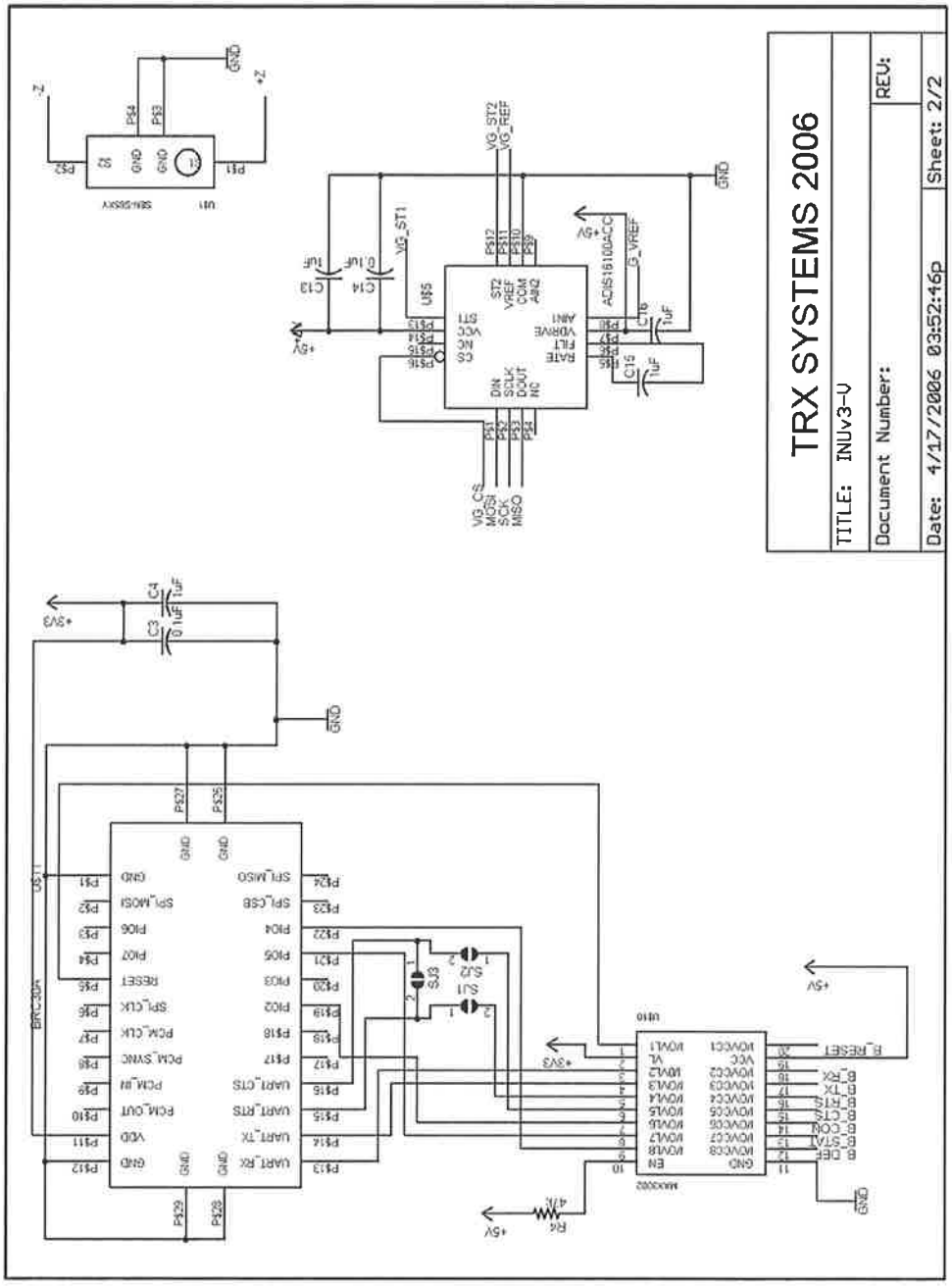

TRX SYSTEMS 2006
TITLE: INUv3-U
Document Number:
REV:
Date: 4/17/2006 03:52:46p
Sheet: 2/2

Fig. 5

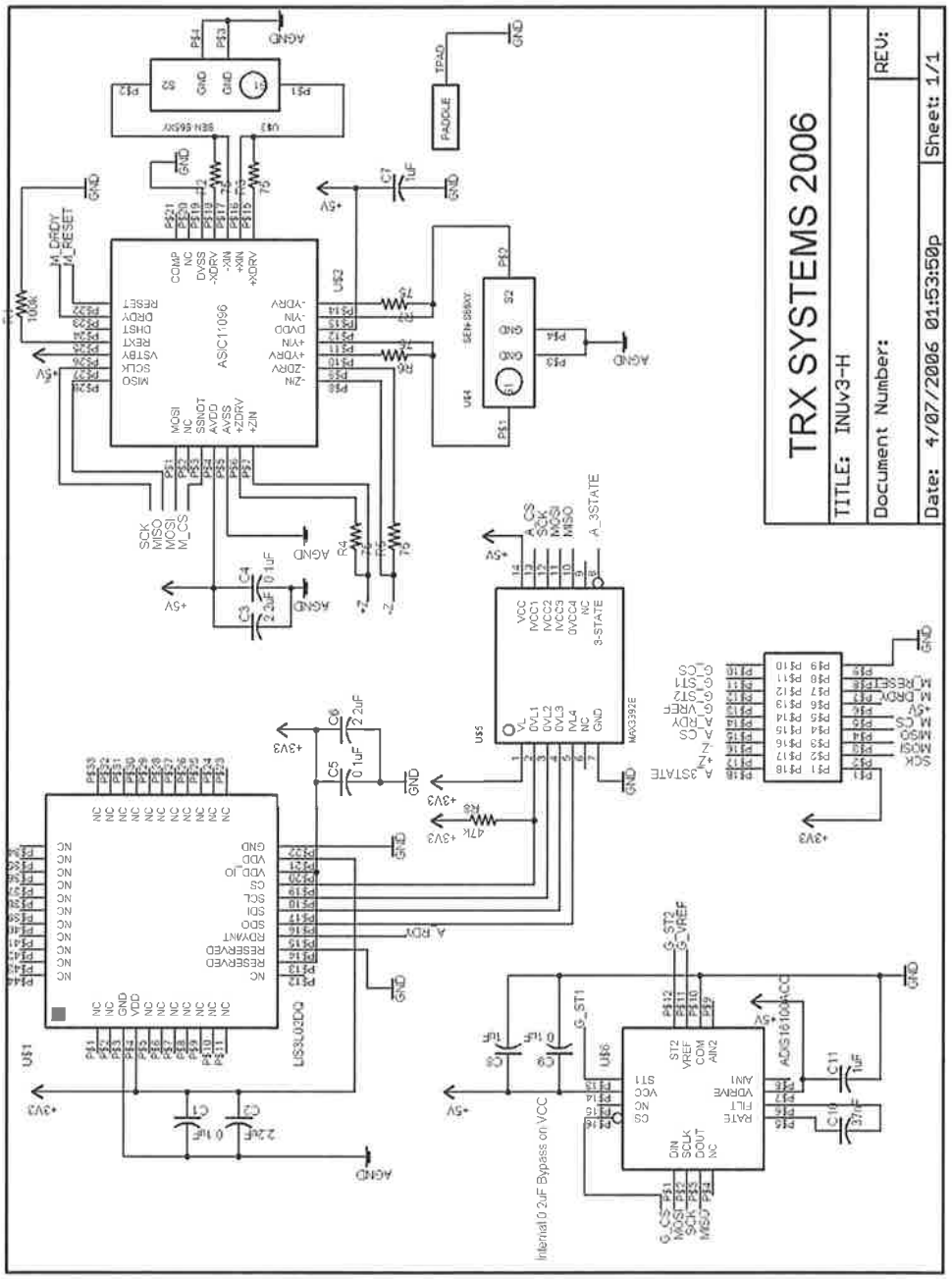

TRX SYSTEMS 2006
TITLE: INUv3-H
Document Number:
REV:
Date: 4/07/2006 01:53:50p
Sheet: 1/1
ASIC11096
LIS3L02DQ
MAX3392E
ADIS16100ACC
Internal 0.2uF Bypass on VCC

Fig. 6

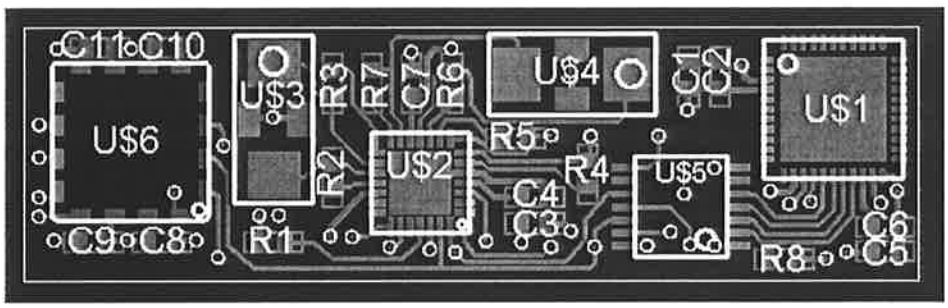

C11
C10
U$6
U$3
R3
R7
C7
R6
U$4
C1
C2
U$1
R5
R2
U$2
R4
U$5
C4
C3
C9
C8
R1
R8
C6
C5

Fig. 7

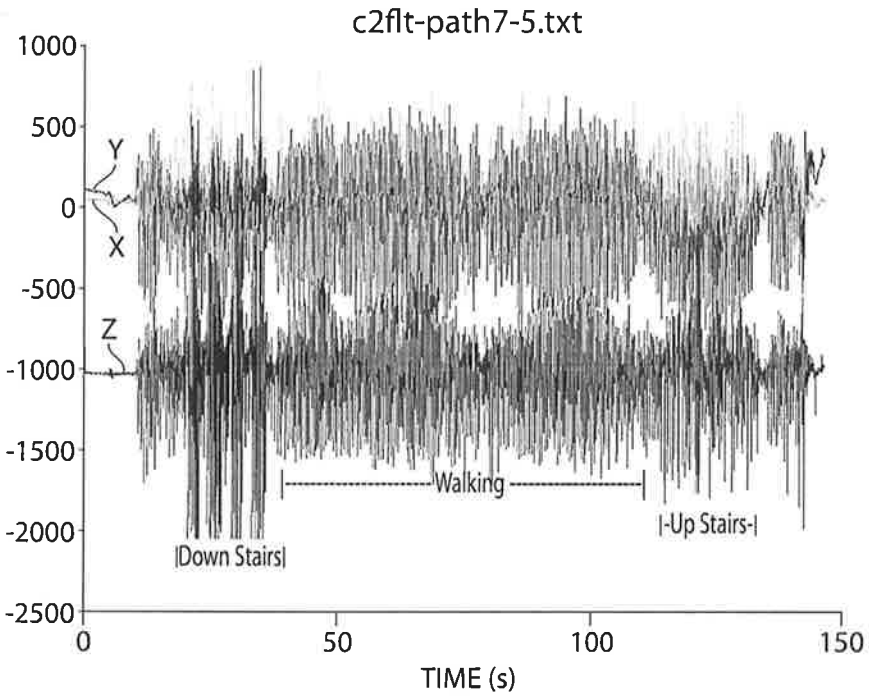

c2flt-path7-5.txt
1000
500
0
-500
-1000
-1500
-2000
-2500
Y
X
Z
Walking
|Down Stairs|
|-Up Stairs-|
0
50
100
150
TIME (s)

Fig. 8

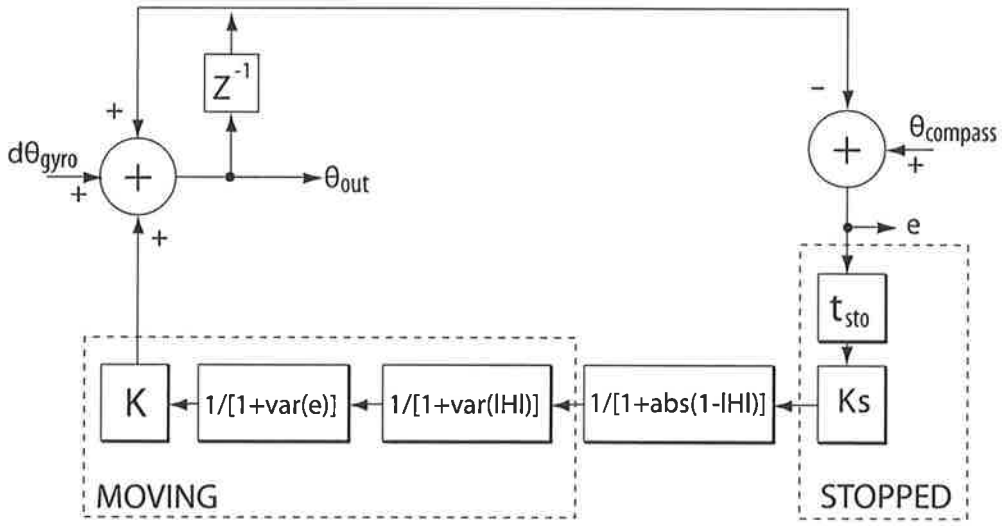

Z^{-1}
+
$d\theta_{gyro}$
+
+
+
θ_{out}
-
$\theta_{compass}$
+
e
t_{sto}
K
1/[1+var(e)]
1/[1+var(IHI)]
1/[1+abs(1-IHI)]
Ks
MOVING
STOPPED

Fig. 9

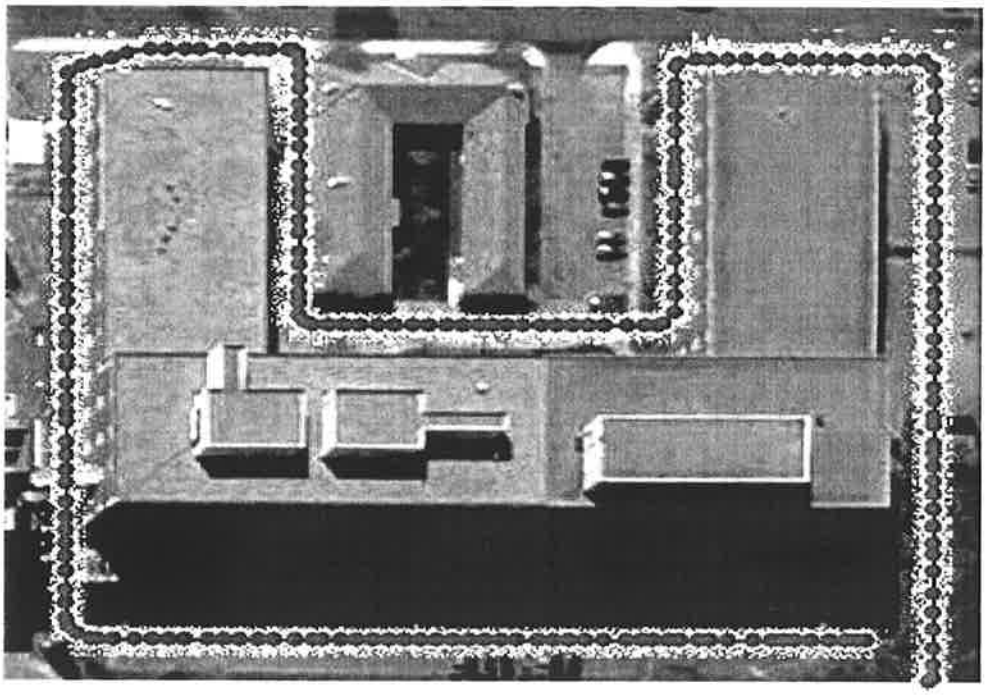


Fig. 10

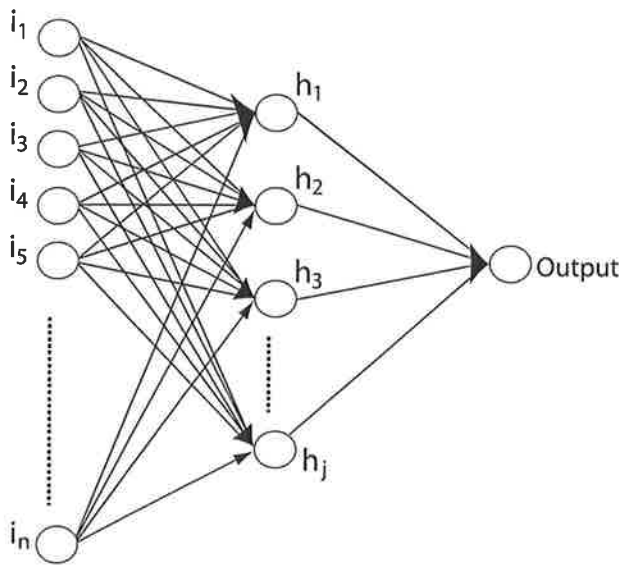


Fig. 11

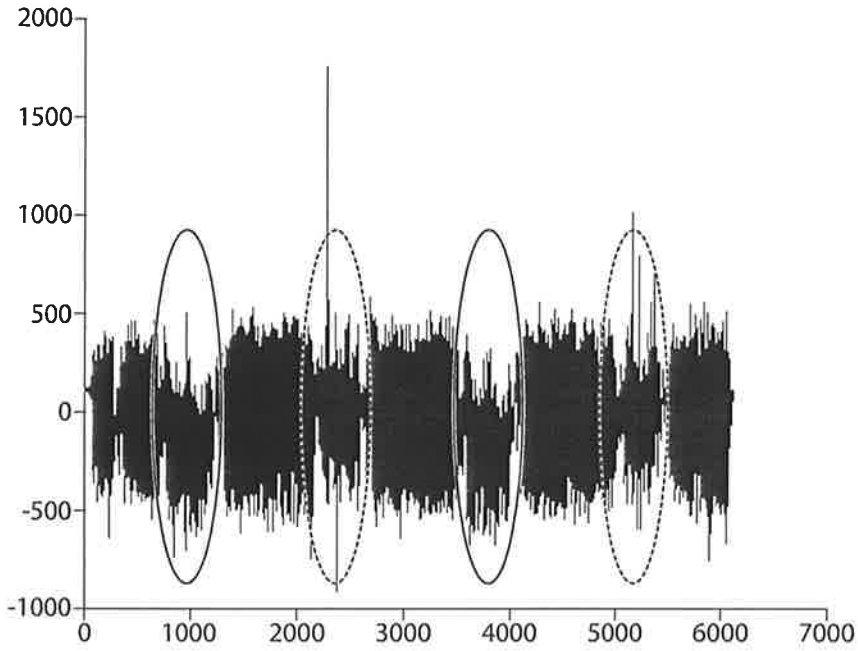

2000
1500
1000
500
0
-500
-1000
0
1000
2000
3000
4000
5000
6000
7000

Fig. 12

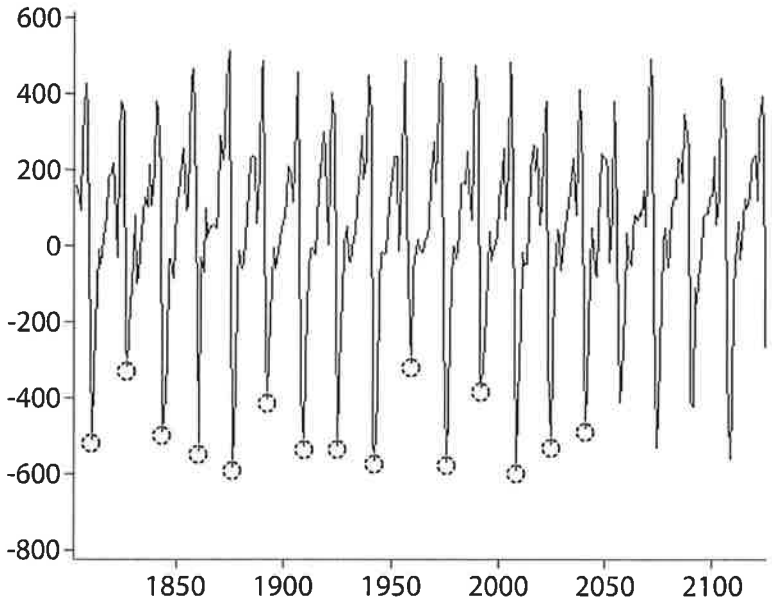


Fig. 13

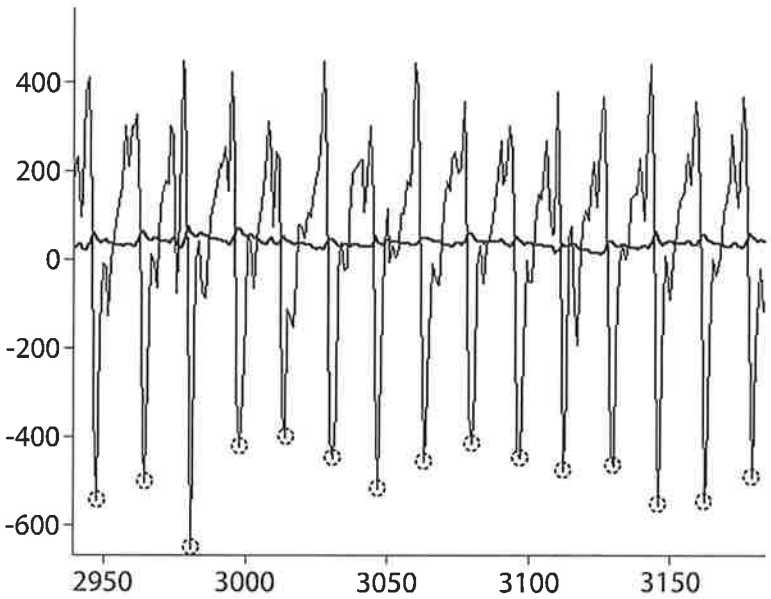
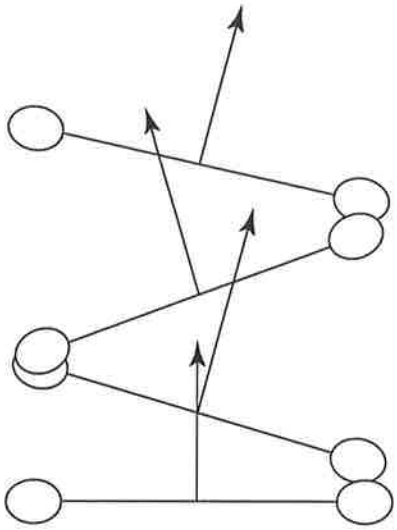


Fig. 14



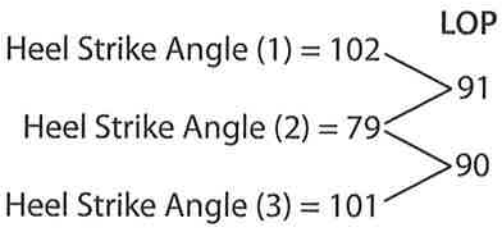

LOP
Heel Strike Angle (1) = 102
91
Heel Strike Angle (2) = 79
90
Heel Strike Angle (3) = 101

Fig. 15

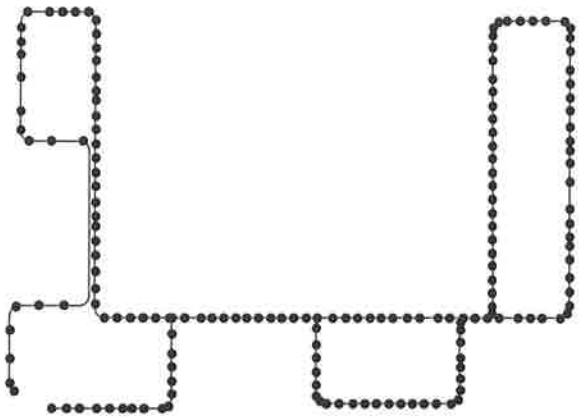


Fig. 16

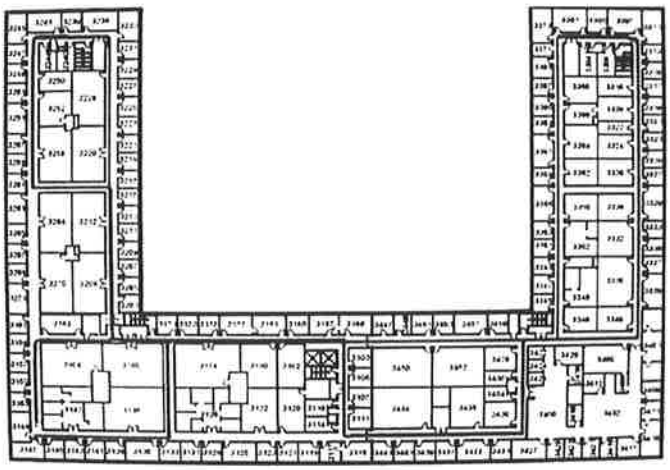


Fig. 17

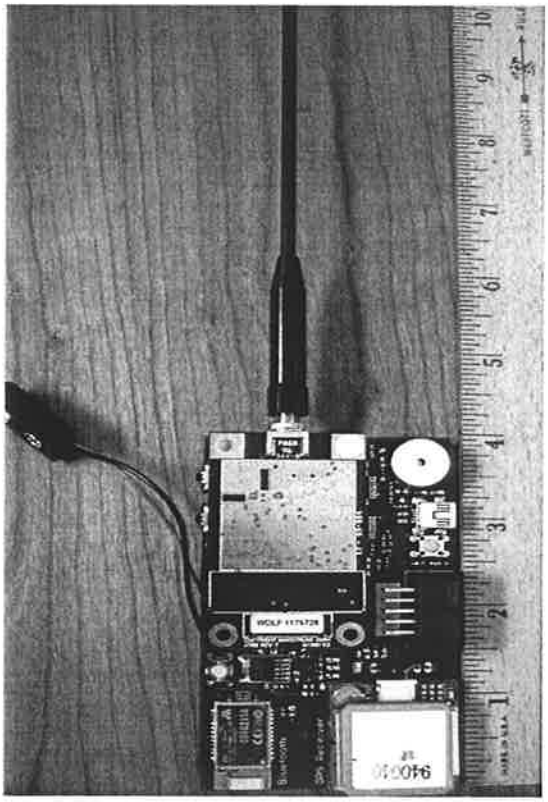


Fig. 18

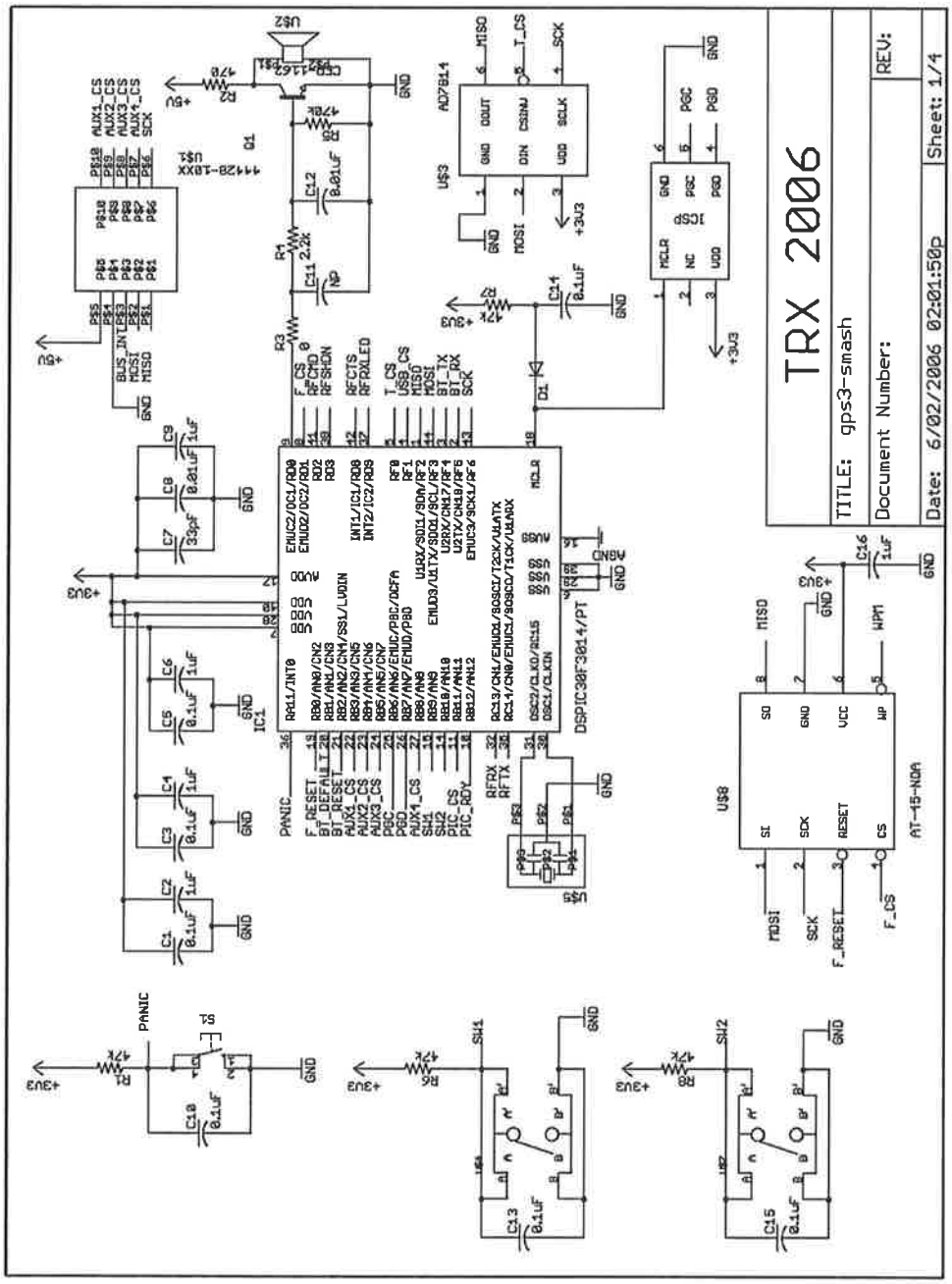

TRX 2006
TITLE: gps3-smash
Document Number:
REV:
Date: 6/02/2006 02:01:50p
Sheet: 1/4
DSPIC30F3014/PT
AT-45-NDA
AD7814
ICSP
PANIC
MOSI
SCK
F_RESET
F_CS
MISO
+3V3
GND

Fig. 19

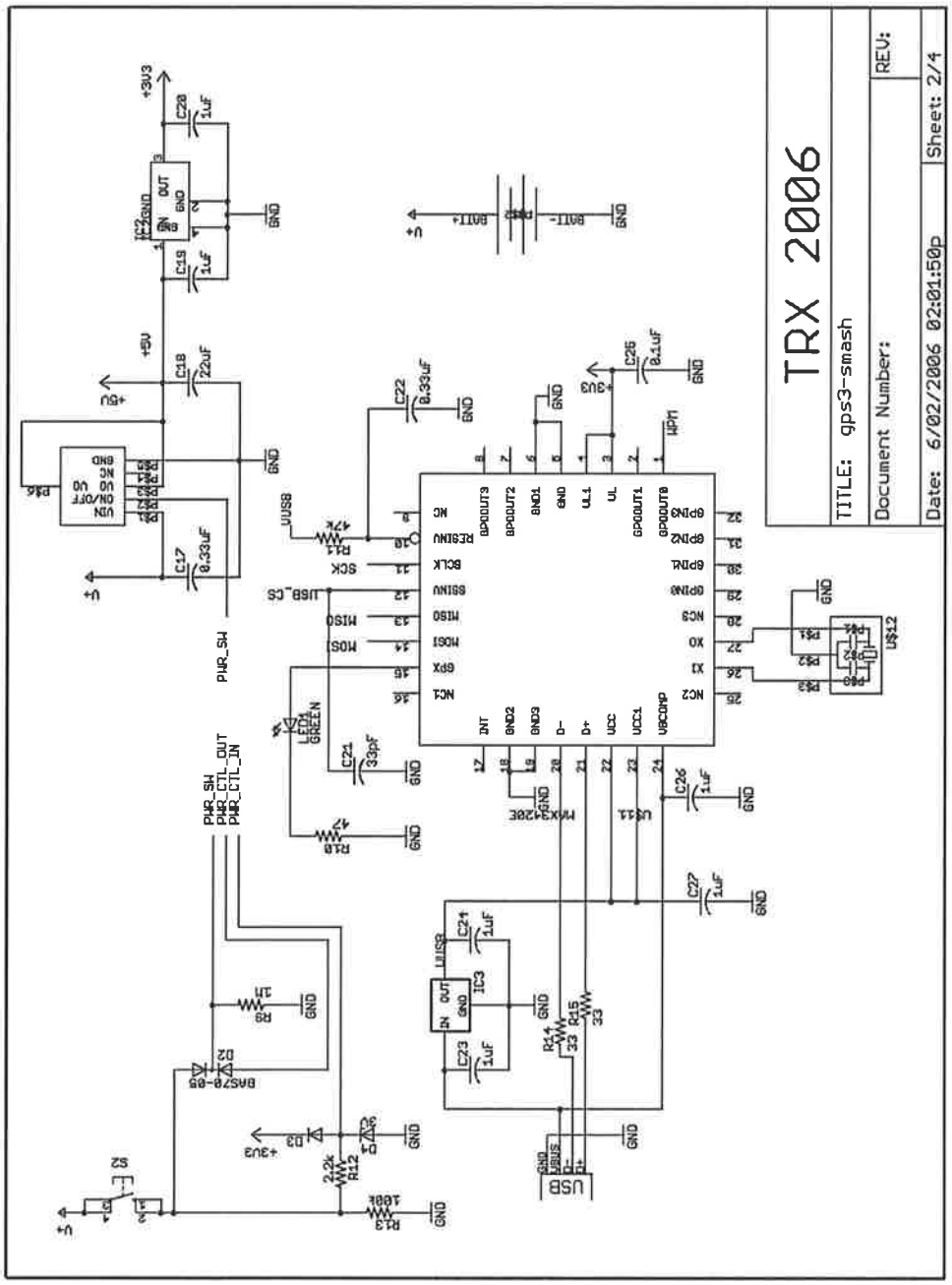

TRX 2006
TITLE: gps3-smash
Document Number:
REV:
Date: 6/02/2006 02:01:50p
Sheet: 2/4

Fig. 20

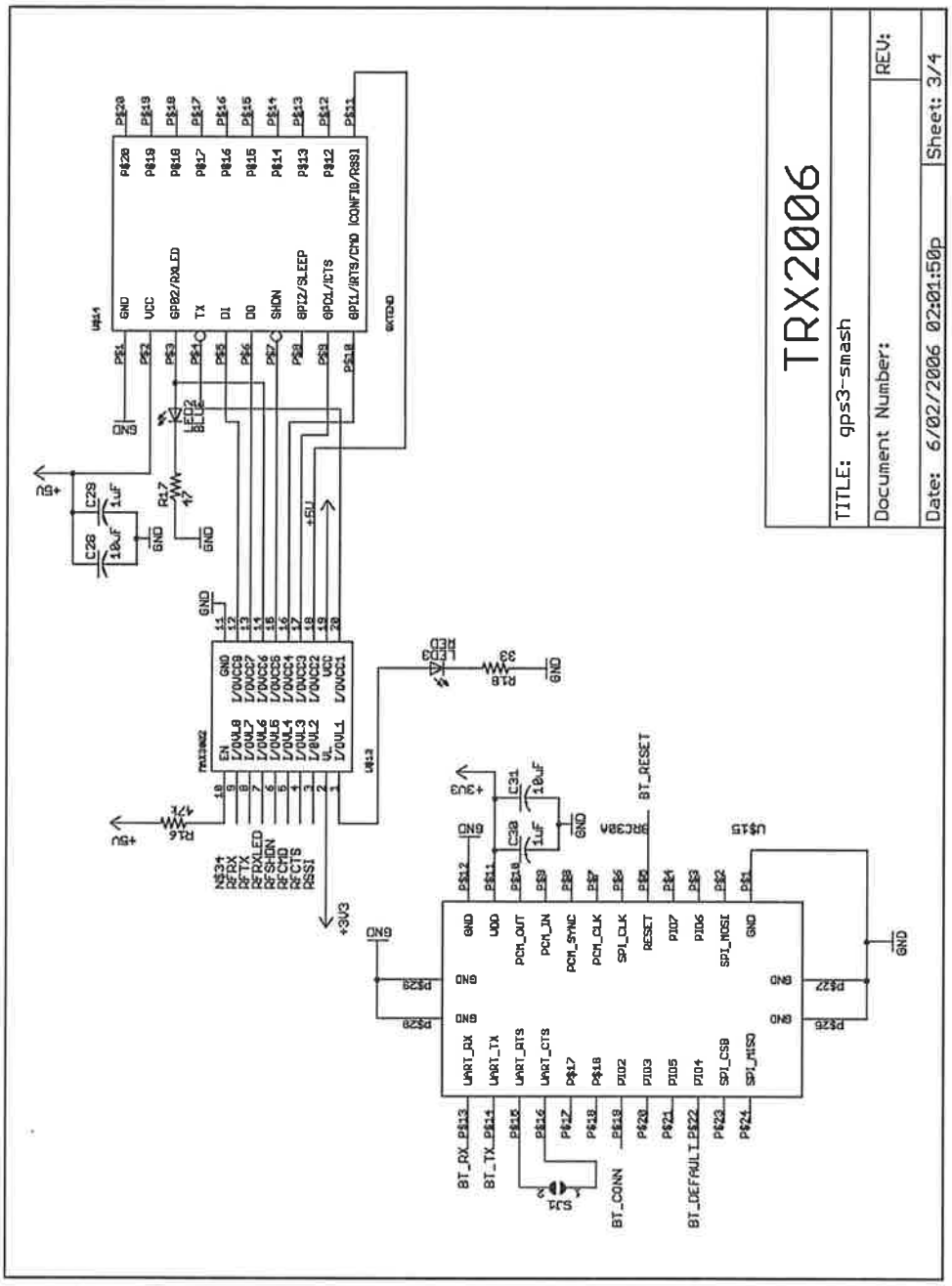

TRX2006
TITLE: gps3-smash
Document Number:
REV:
Date: 6/02/2006 02:01:50p
Sheet: 3/4

Fig. 21

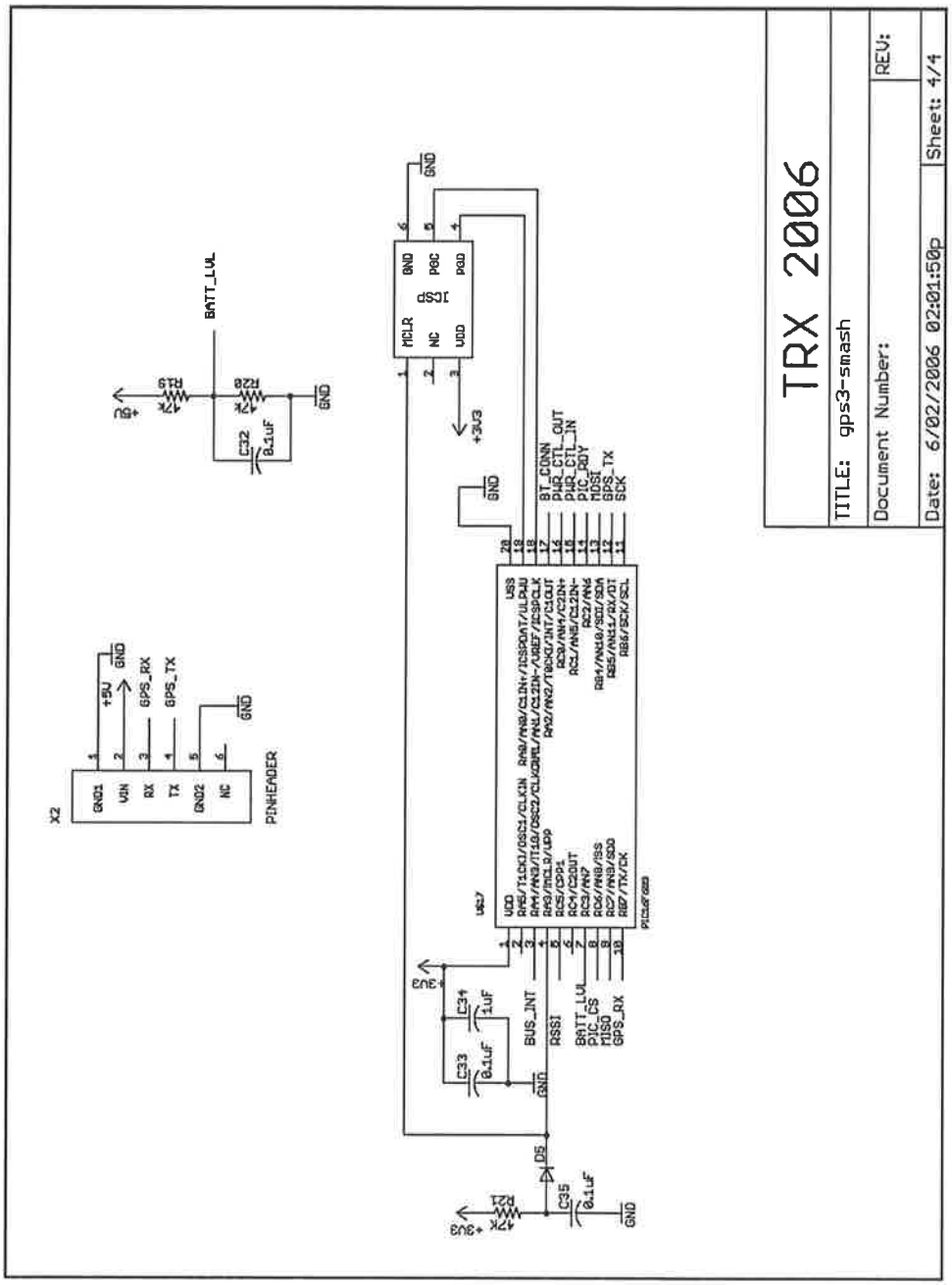

TRX 2006
TITLE: gps3-smash
Document Number:
REV:
Date: 6/02/2006 02:01:50p
Sheet: 4/4
X2
PINHEADER
ICSP
BATT_LVL
BUS_INT
RSSI
BATT_LVL
PIC_CS
MISO
GPS_RX
GPS_TX
BT_CONN
PWR_CTL_OUT
PWR_CTL_IN
PIC_RDY
MOSI
GPS_TX
SCK
+5V
+3V3
GND

Fig. 22

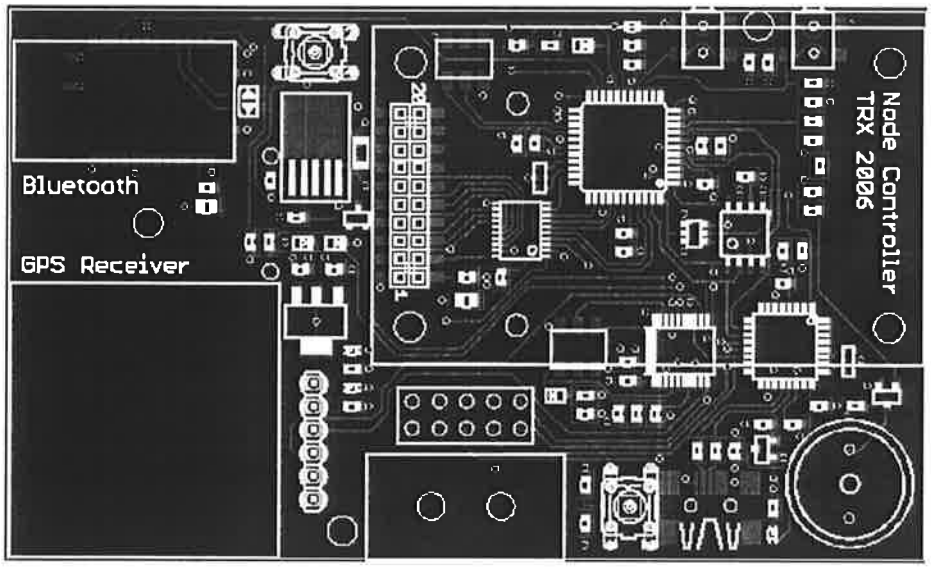


Fig. 23

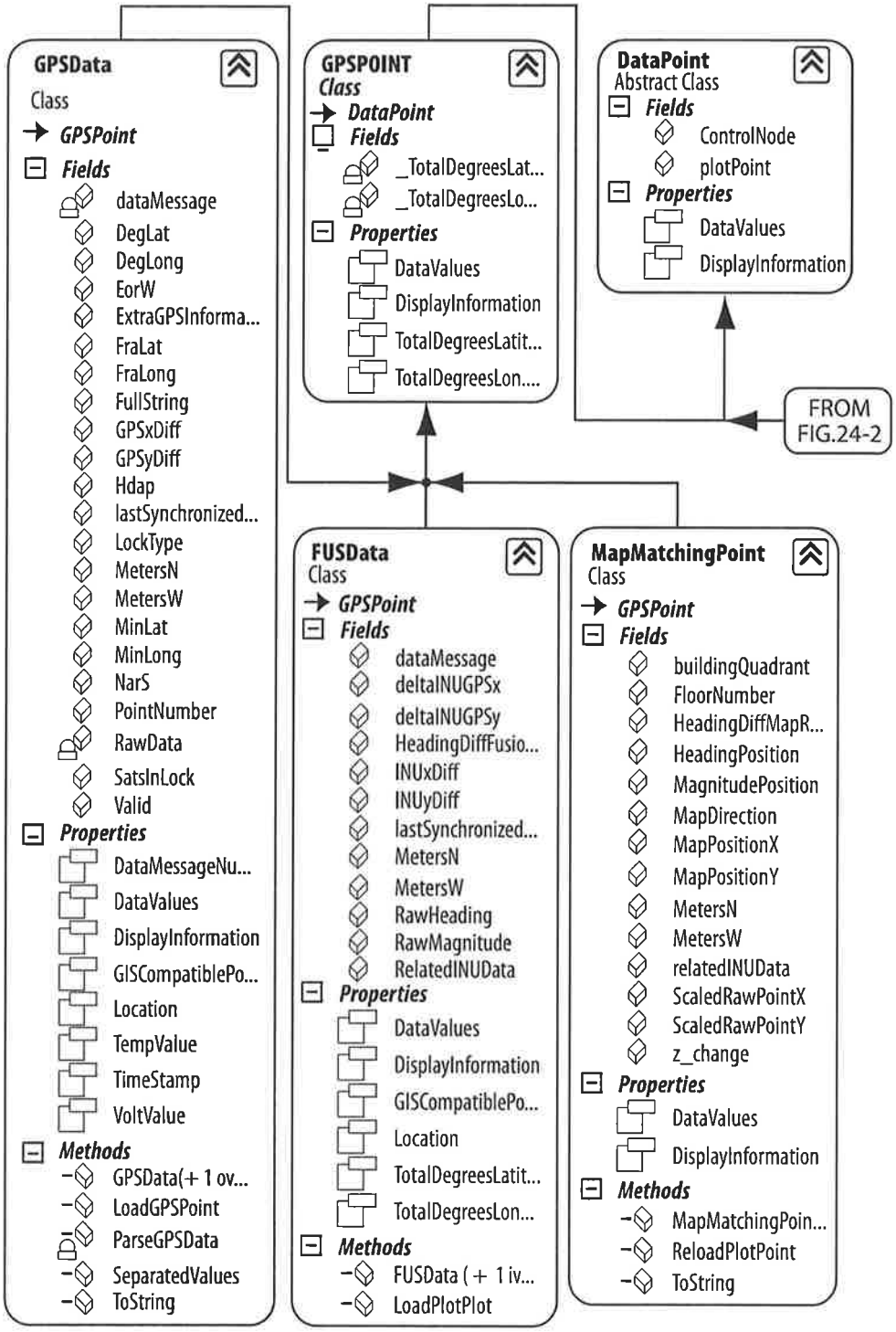

GPSData
Class
GPSPoint
Fields
dataMessage
DegLat
DegLong
EorW
ExtraGPSInforma...
FraLat
FraLong
FullString
GPSxDiff
GPSyDiff
Hdap
lastSynchronized...
LockType
MetersN
MetersW
MinLat
MinLong
NarS
PointNumber
RawData
SatsInLock
Valid
Properties
DataMessageNu...
DataValues
DisplayInformation
GISCompatiblePo...
Location
TempValue
TimeStamp
VoltValue
Methods
GPSData(+ 1 ov...
LoadGPSPoint
ParseGPSData
SeparatedValues
ToString
GPSPOINT
Class
DataPoint
Fields
_TotalDegreesLat...
_TotalDegreesLo...
Properties
DataValues
DisplayInformation
TotalDegreesLatit...
TotalDegreesLon....
DataPoint
Abstract Class
Fields
ControlNode
plotPoint
Properties
DataValues
DisplayInformation
FROM FIG.24-2
FUSData
Class
GPSPoint
Fields
dataMessage
deltaINUGPSx
deltaINUGPSy
HeadingDiffFusio...
INUxDiff
INUyDiff
lastSynchronized...
MetersN
MetersW
RawHeading
RawMagnitude
RelatedINUData
Properties
DataValues
DisplayInformation
GISCompatiblePo...
Location
TotalDegreesLatit...
TotalDegreesLon...
Methods
FUSData (+ 1 iv...
LoadPlotPlot
MapMatchingPoint
Class
GPSPoint
Fields
buildingQuadrant
FloorNumber
HeadingDiffMapR...
HeadingPosition
MagnitudePosition
MapDirection
MapPositionX
MapPositionY
MetersN
MetersW
relatedINUData
ScaledRawPointX
ScaledRawPointY
z_change
Properties
DataValues
DisplayInformation
Methods
MapMatchingPoin...
ReloadPlotPoint
ToString

Fig. 24-1

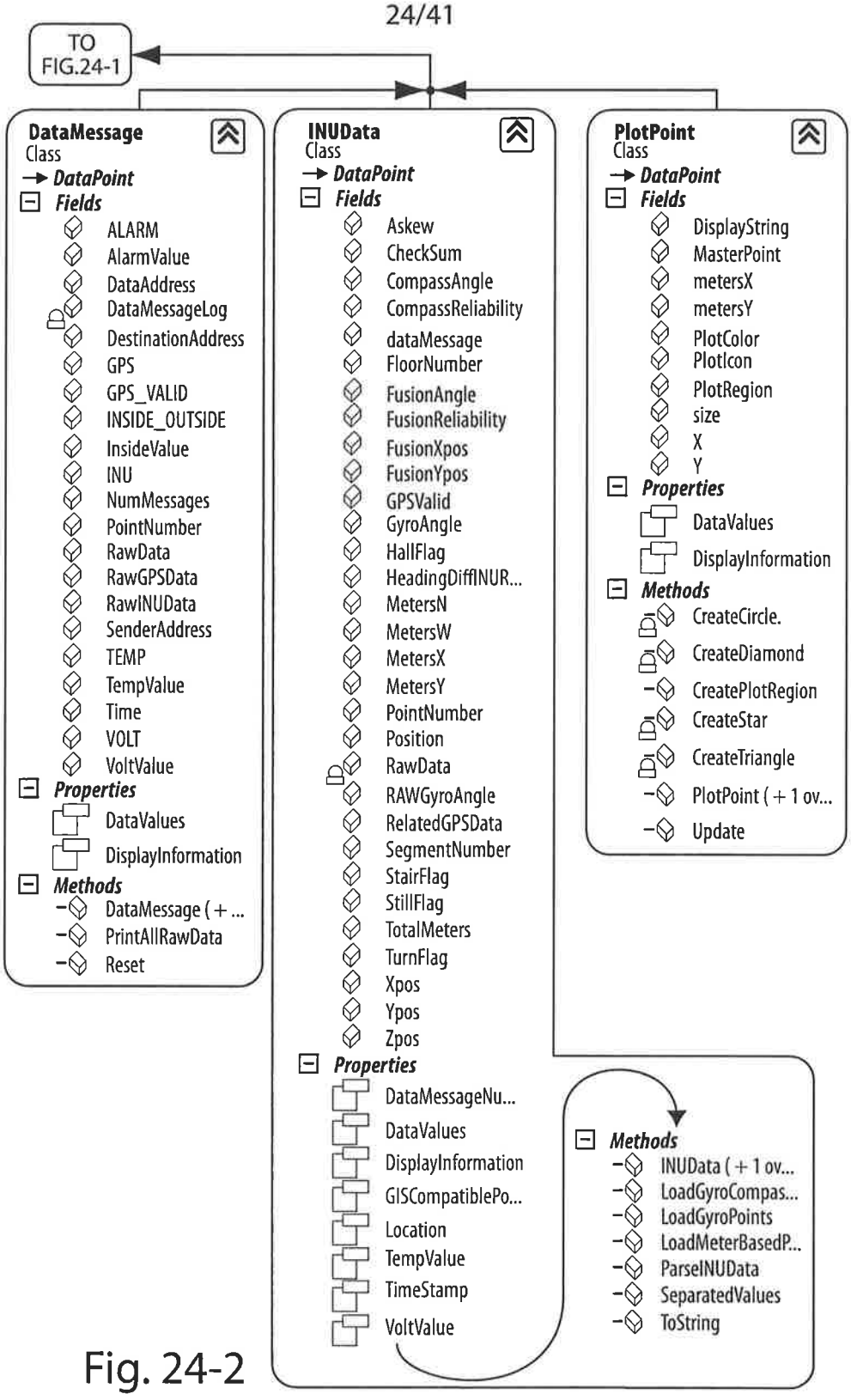
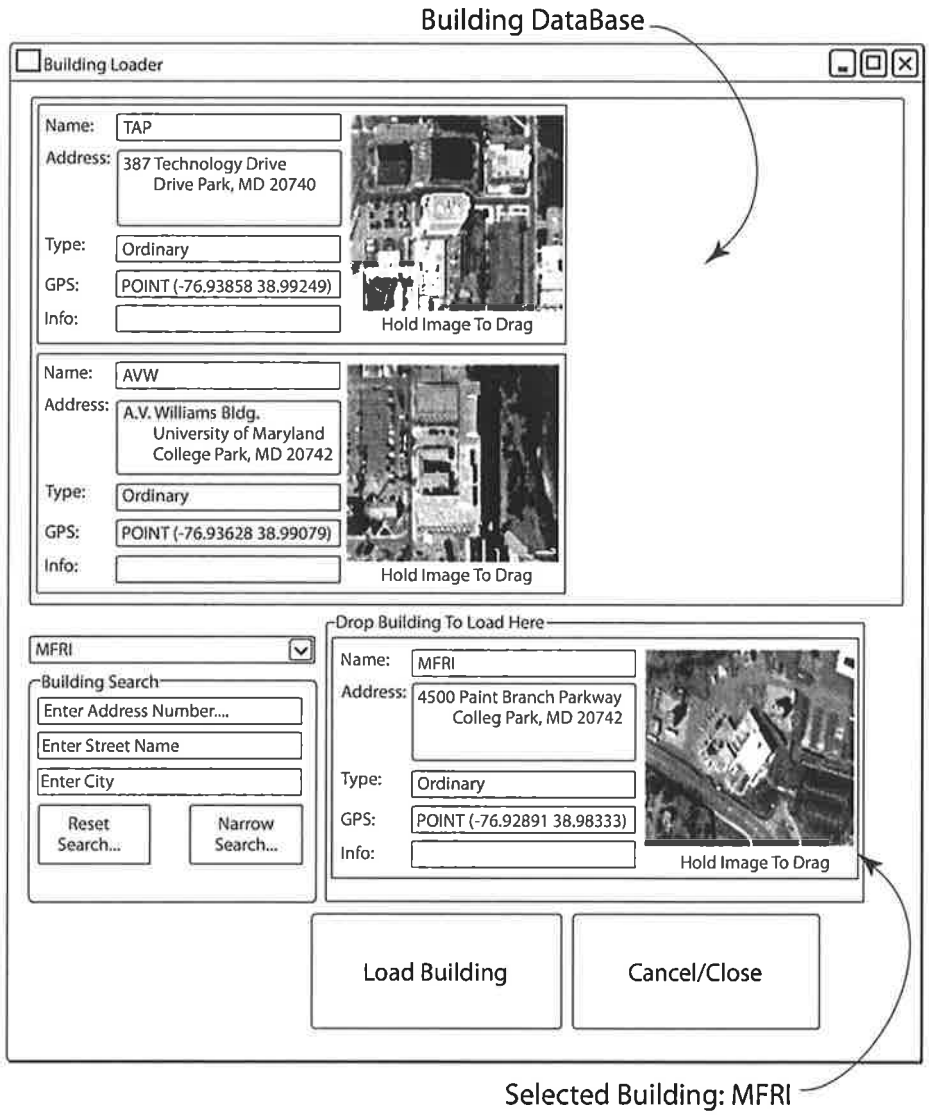

TO FIG.24-1
DataMessage
Class
DataPoint
Fields
ALARM
AlarmValue
DataAddress
DataMessageLog
DestinationAddress
GPS
GPS_VALID
INSIDE_OUTSIDE
InsideValue
INU
NumMessages
PointNumber
RawData
RawGPSData
RawINUData
SenderAddress
TEMP
TempValue
Time
VOLT
VoltValue
Properties
DataValues
DisplayInformation
Methods
DataMessage (+ ...
PrintAllRawData
Reset
INUData
Class
DataPoint
Fields
Askew
CheckSum
CompassAngle
CompassReliability
dataMessage
FloorNumber
FusionAngle
FusionReliability
FusionXpos
FusionYpos
GPSValid
GyroAngle
HallFlag
HeadingDiffINUR...
MetersN
MetersW
MetersX
MetersY
PointNumber
Position
RawData
RAWGyroAngle
RelatedGPSData
SegmentNumber
StairFlag
StillFlag
TotalMeters
TurnFlag
Xpos
Ypos
Zpos
Properties
DataMessageNu...
DataValues
DisplayInformation
GISCompatiblePo...
Location
TempValue
TimeStamp
VoltValue
Methods
INUData (+ 1 ov...
LoadGyroCompas...
LoadGyroPoints
LoadMeterBasedP...
ParseINUData
SeparatedValues
ToString
PlotPoint
Class
DataPoint
Fields
DisplayString
MasterPoint
metersX
metersY
PlotColor
PlotIcon
PlotRegion
size
X
Y
Properties
DataValues
DisplayInformation
Methods
CreateCircle.
CreateDiamond
CreatePlotRegion
CreateStar
CreateTriangle
PlotPoint (+ 1 ov...
Update

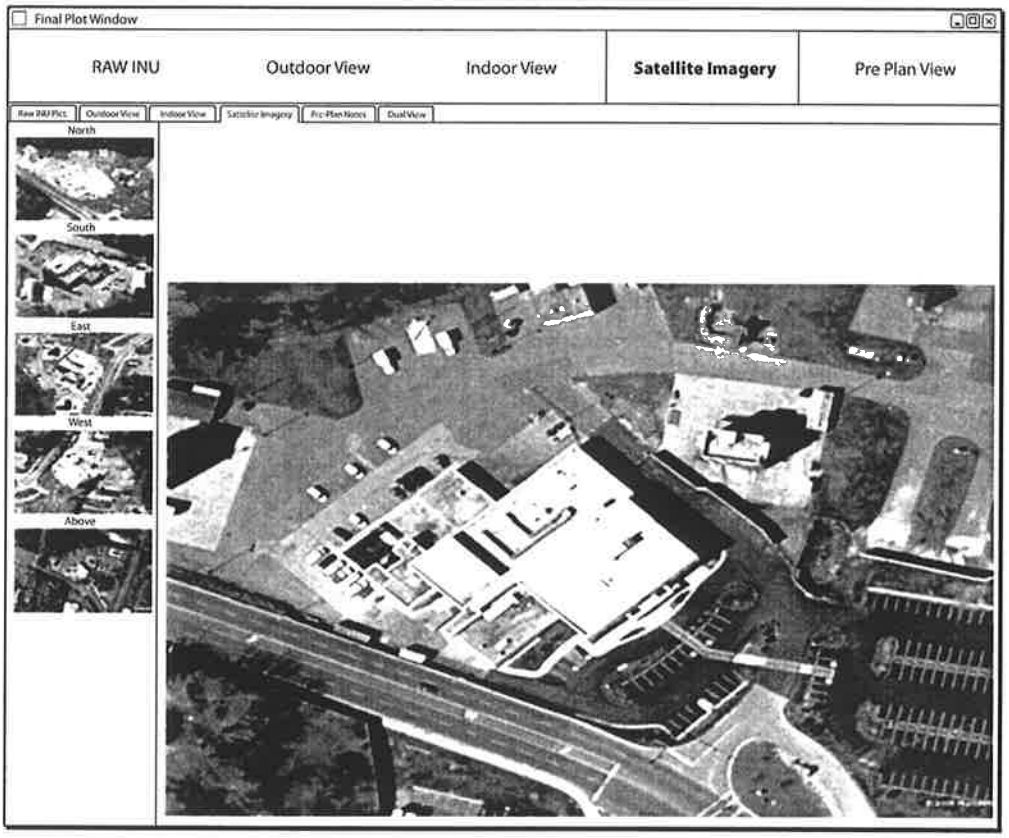
Fig. 24-2



The ***Sentinel Building Loader*** loads the active building into the ***Sentinel System***.
Buildings can be loaded manually by selecting them.
Buildings can be loaded automatically by address searches which will be received at the 911 Box Call at Dispatch.
Multiple Buildings can be loaded at once.

Fig. 25

Sentinel System Satelite Views



The SATELITE IMAGERY tab allows the Incident Commanders and firefighters to plan the mission on the way to the incident scene and at the scene.
It provides geographic and structural awareness of the surrounding area.

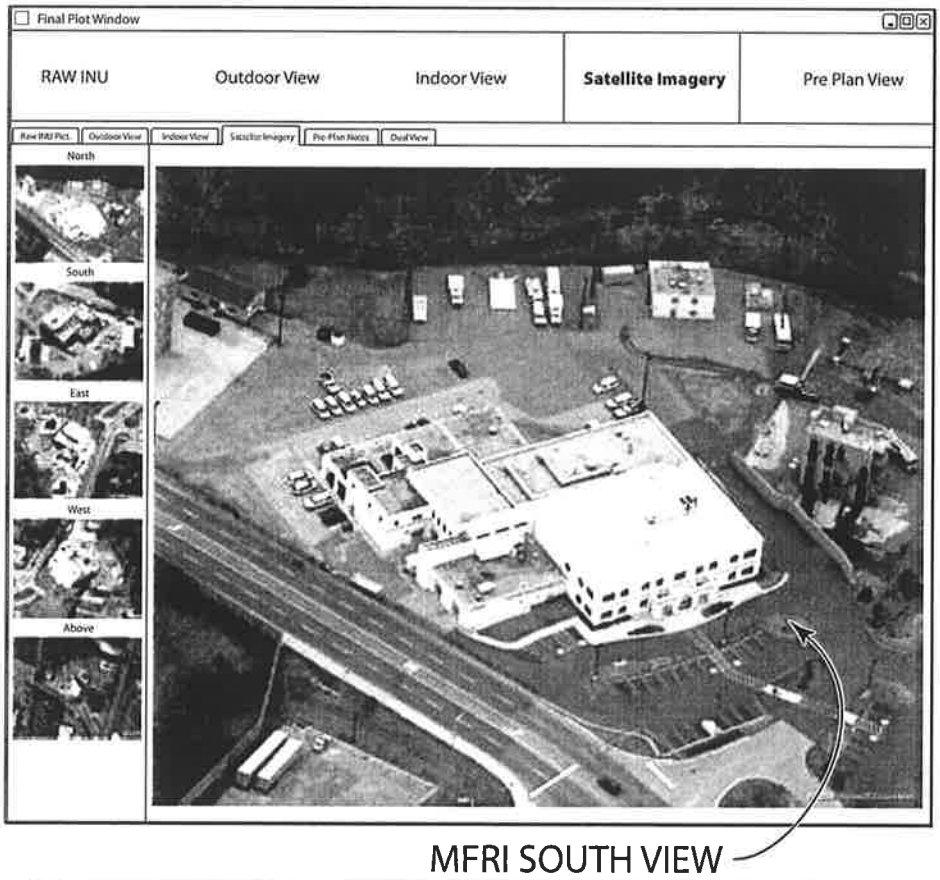
TOP VIEW: The top view reveals critical roof information for Roof and Venting operations.

N,S,E,W views provide side views of the building revealing window, exit and other structural information.

From: *Microsoft Live Locals*

Fig. 26

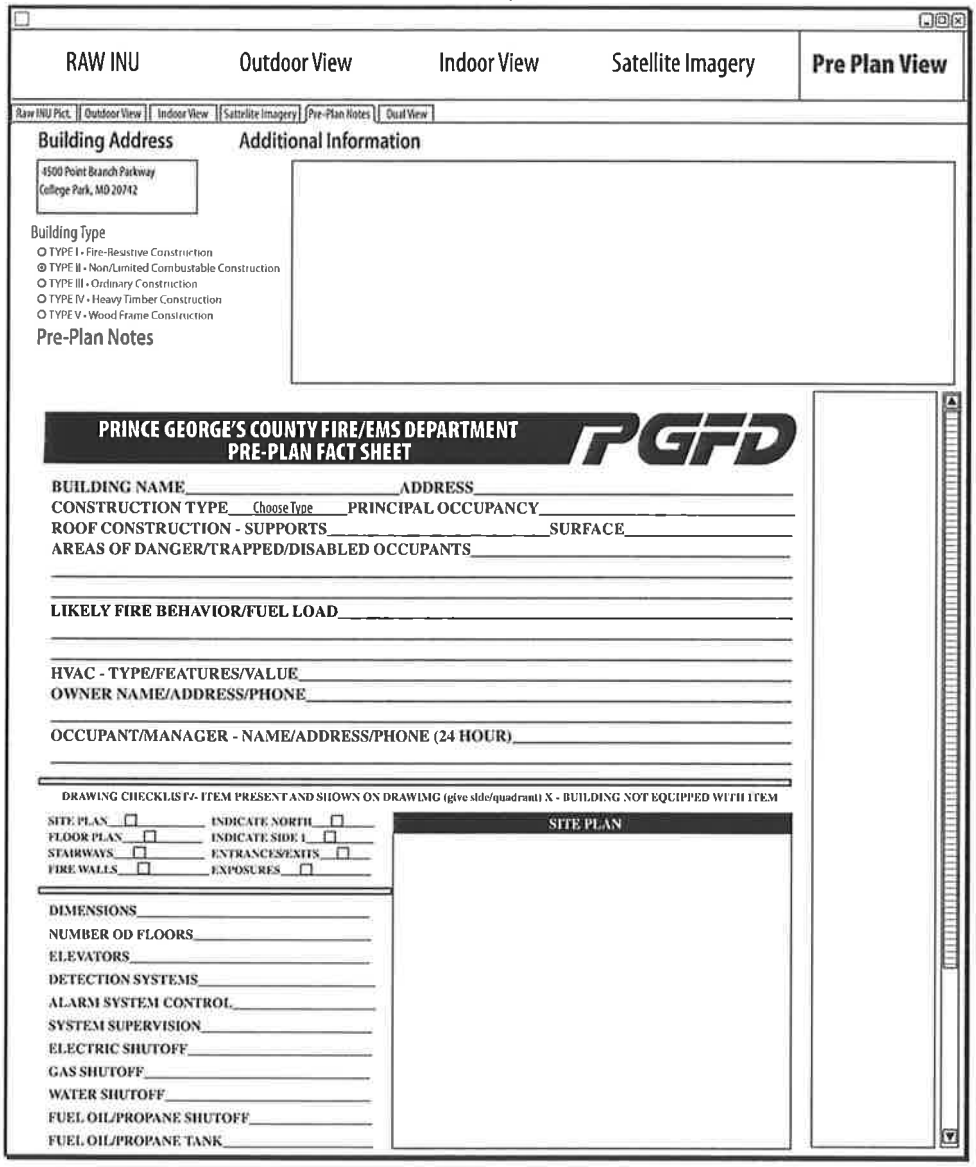
Sentinel System Satelite Views



The ***Sentinel System*** provides views of the building from the NORTH, SOUTH, EAST, and WEST, to give the Incident Commander complete awareness of the Incident Scene.

Fig. 27

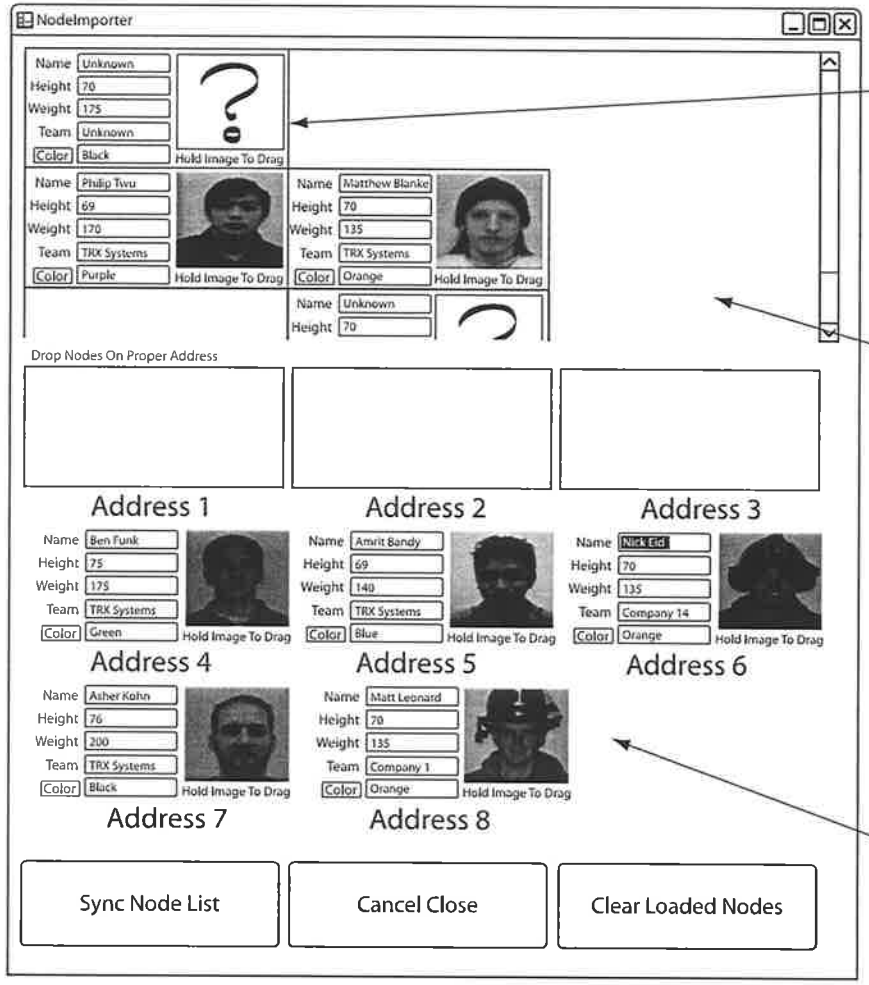
Sentinel Preplan View



The SENTINEL PRE-PLAN VIEW allows firefighters to view their preplan notes within the ***Sentinel System Base Station*** while getting to the incident scene and at the scene.

New Notes and ***Additional Information*** and ***Lessons*** learnt for the building can be saved to the ***DataBase*** from quick reference on the next call to the location.

Fig. 28



New Personnel Creator

Creates a new personnel and records height etc, and selects color to use on the display. New Personnel is added to personnel database.

Current Database

The Sentinel Personnel Loader loads the active personnel into the Sentinel System.

The System will be preloaded with regular personnel in the team

A new personnel can be created at the scene if needed.

Currently Active Personnel

Fig. 29

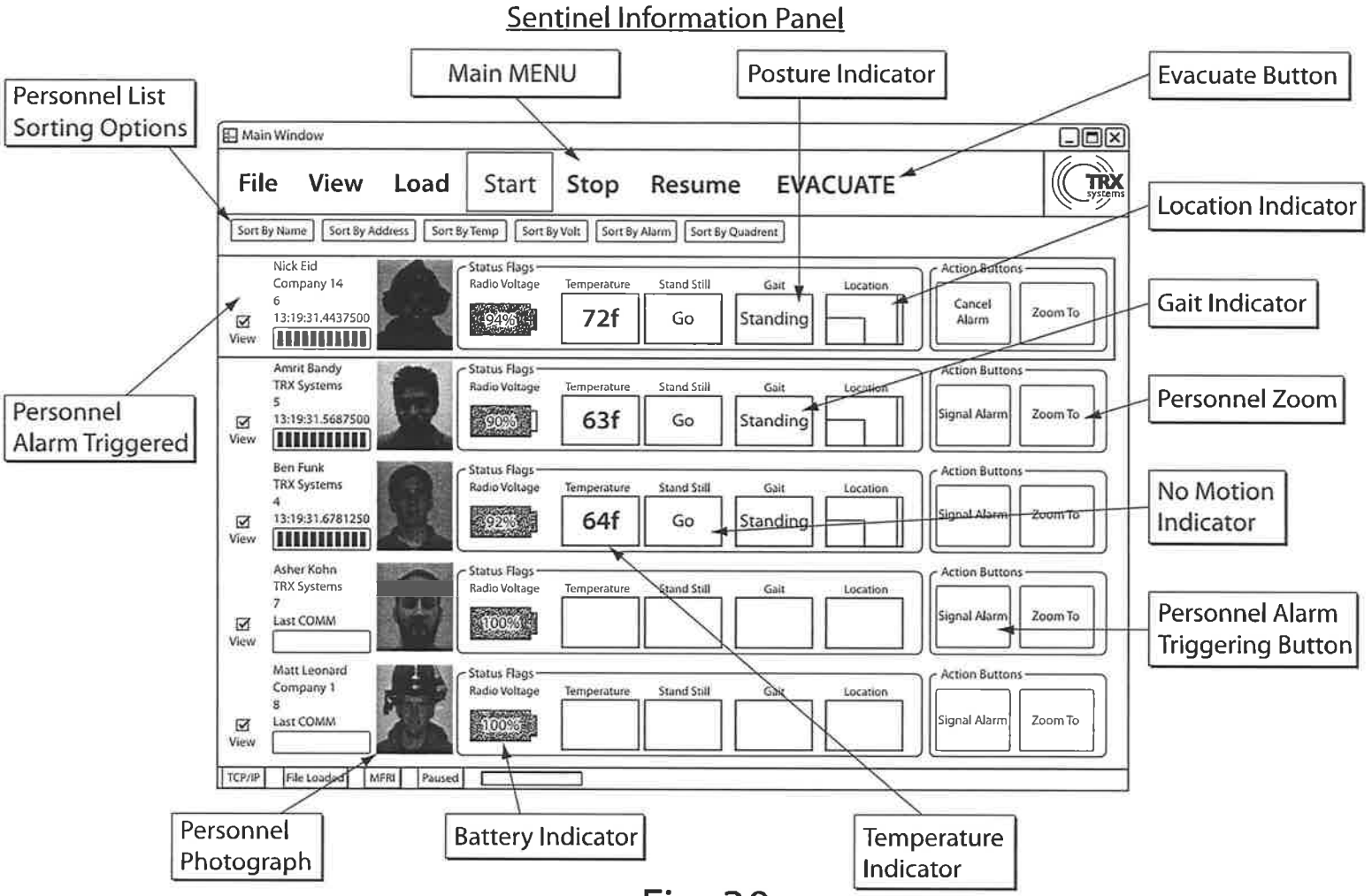
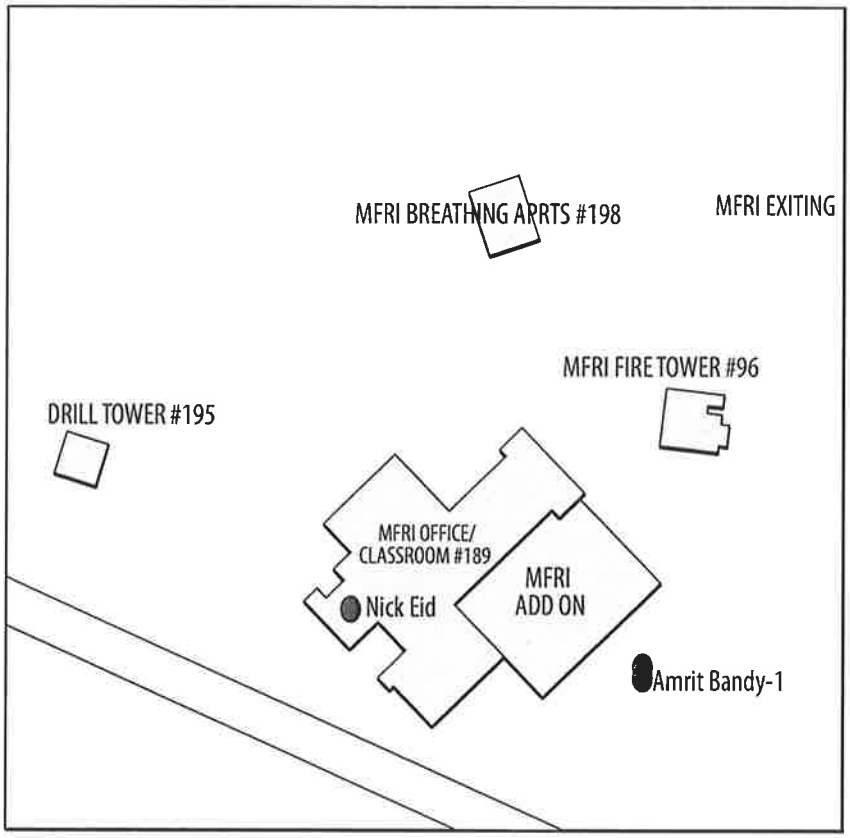

Sentinel Information Panel
Main MENU
Posture Indicator
Evacuate Button
Personnel List Sorting Options
Location Indicator
Gait Indicator
Personnel Alarm Triggered
Personnel Zoom
No Motion Indicator
Personnel Alarm Triggering Button
Personnel Photograph
Battery Indicator
Temperature Indicator
Main Window
File View Load Start Stop Resume EVACUATE
Sort By Name Sort By Address Sort By Temp Sort By Volt Sort By Alarm Sort By Quadrent
Nick Eid
Company 14
6
13:19:31.4437500
Amrit Bandy
TRX Systems
5
13:19:31.5687500
Ben Funk
TRX Systems
4
13:19:31.6781250
Asher Kohn
TRX Systems
7
Last COMM
Matt Leonard
Company 1
8
Last COMM
Status Flags
Radio Voltage
Temperature
Stand Still
Gait
Location
Action Buttons
94%
72f
Go
Standing
Cancel Alarm
Zoom To
90%
63f
Go
Standing
Signal Alarm
Zoom To
92%
64f
Go
Standing
100%
100%
View
TCP/IP
File Loaded
MFRI
Paused

Fig. 30

Sentinel Outdoor Tracking View

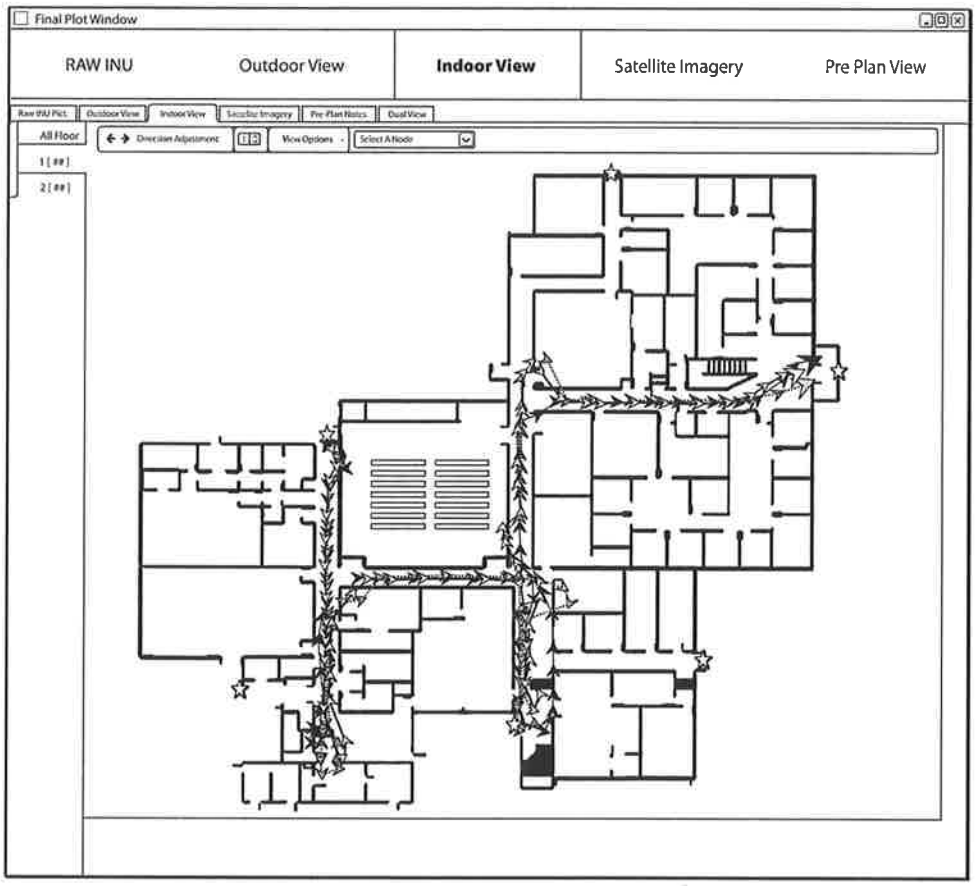


The Outdoor tracking locations are displayed on a GIS Map of the scene.
The Outdoor plot automatically zooms to the loaded incident scene.
The GIS view has been chosen as a result of
- Simplicity of View
- Fewer Colors than satelite imagery
- Standard representation

Figure shows personnel in 'red' *(Nick Eid)* triggering his alarm indoors, while Rescue Team of two is located outdoors at MFRI.

Fig. 31

Sentinel Indoor Tracking View

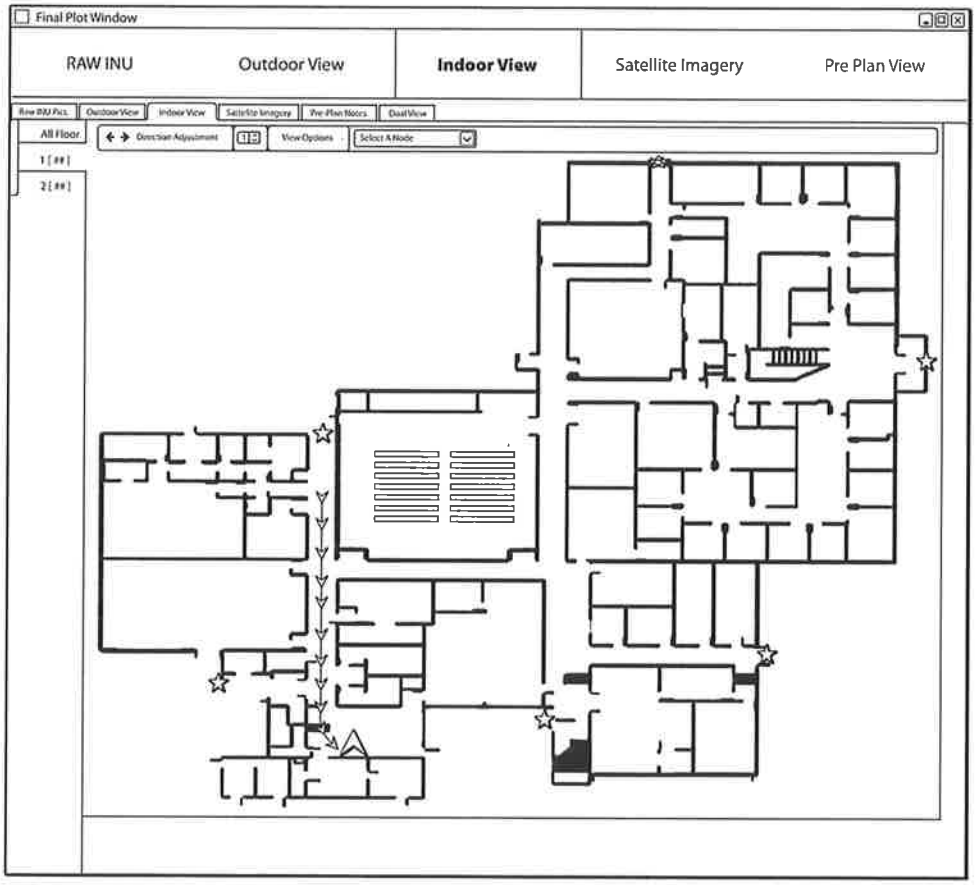


Personnel are displayed in their respective colors with a ticker (arrow) pointing in the direction they are facing. Figure shows three personnel heading for the MFRI main entrance after walking int he building. *Trails are optional.*

The INDOOR VIEW is shown on floor plans of the building.
The left tab allows the incident Commander to select a floor to view and displays the number of personnel on the floor

Fig. 32

Sentinel Indoor Tracking View



When an ALARM is triggered the ticker of the personnel "***in alarm***"is turned red as shown in the picture revealing the location of the distress.

The figure shows the indoor location of the alarm of ***Nick Eid*** shown in the Outdoor View

Fig. 33

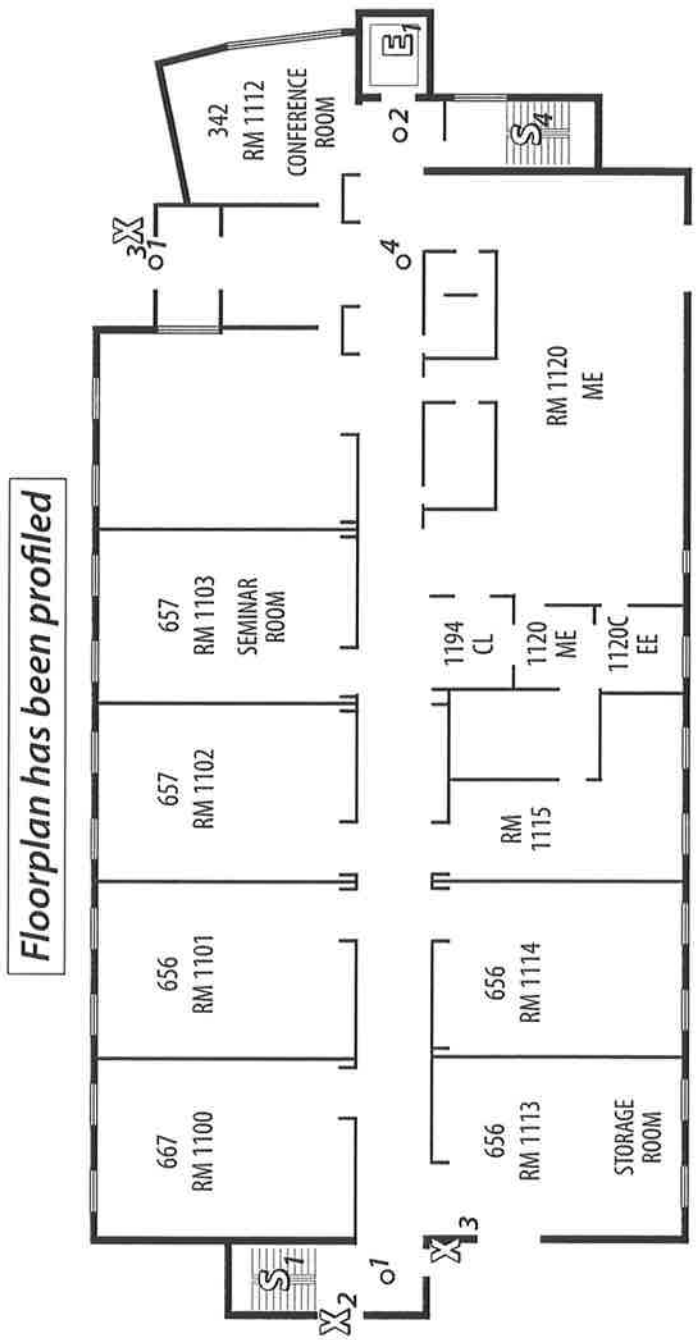

Floorplan has been profiled
667
RM 1100
656
RM 1101
657
RM 1102
657
RM 1103
SEMINAR
ROOM
342
RM 1112
CONFERENCE
ROOM
656
RM 1113
656
RM 1114
RM
1115
1194
CL
1120
ME
1120C
EE
RM 1120
ME
STORAGE
ROOM
S1
S4
E1
X1
X2
X3
O1
O2
O3
O4

Fig. 34

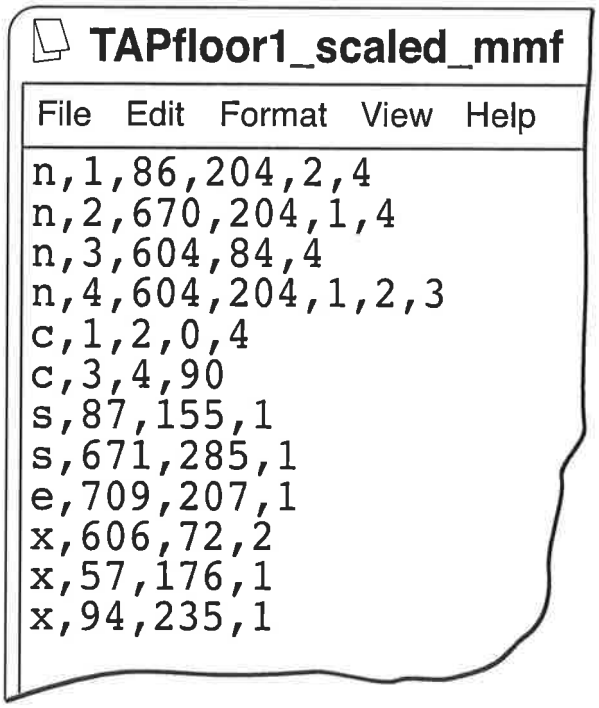

TAPfloor1_scaled_mmf
File Edit Format View Help
n,1,86,204,2,4
n,2,670,204,1,4
n,3,604,84,4
n,4,604,204,1,2,3
c,1,2,0,4
c,3,4,90
s,87,155,1
s,671,285,1
e,709,207,1
x,606,72,2
x,57,176,1
x,94,235,1

Fig. 35

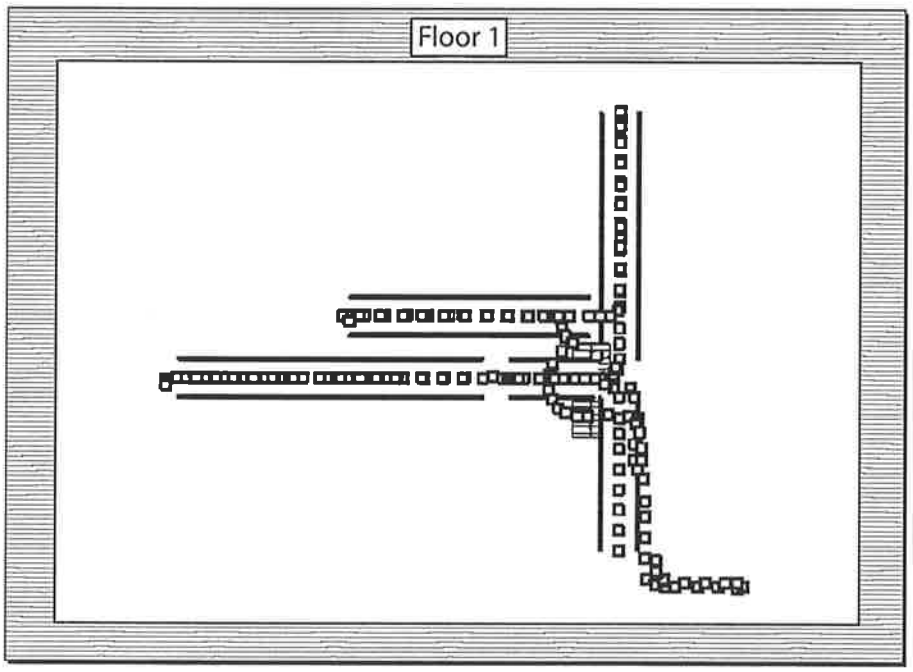


Fig. 36

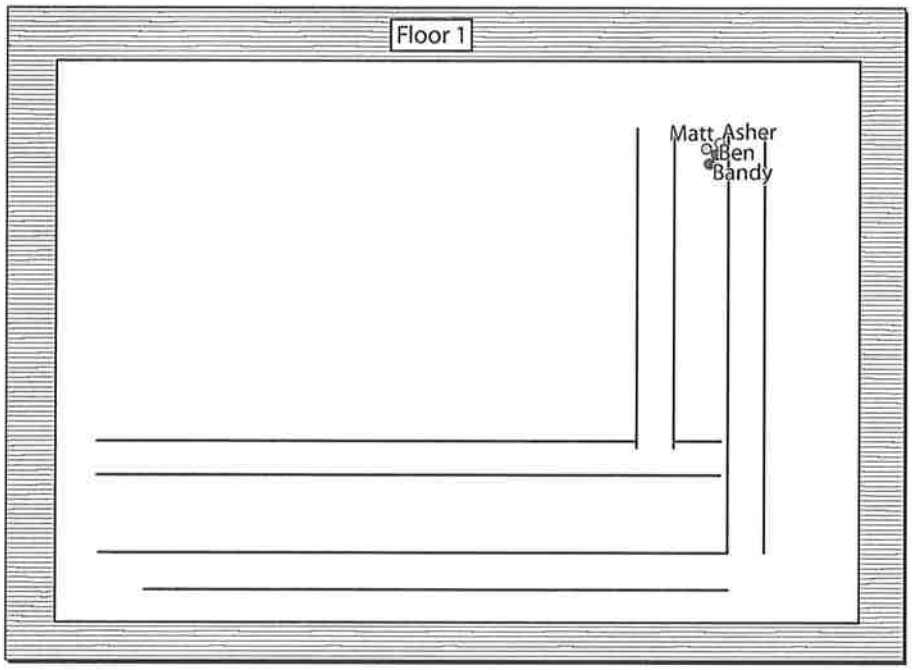


Fig. 37

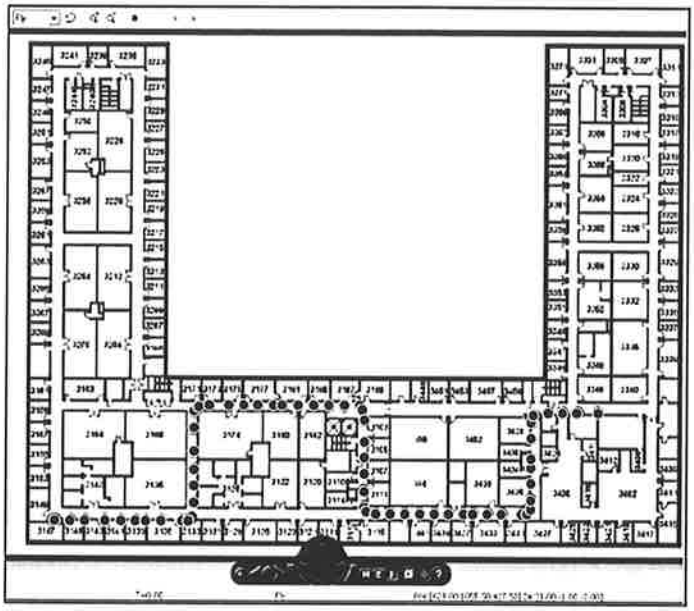


Fig. 38

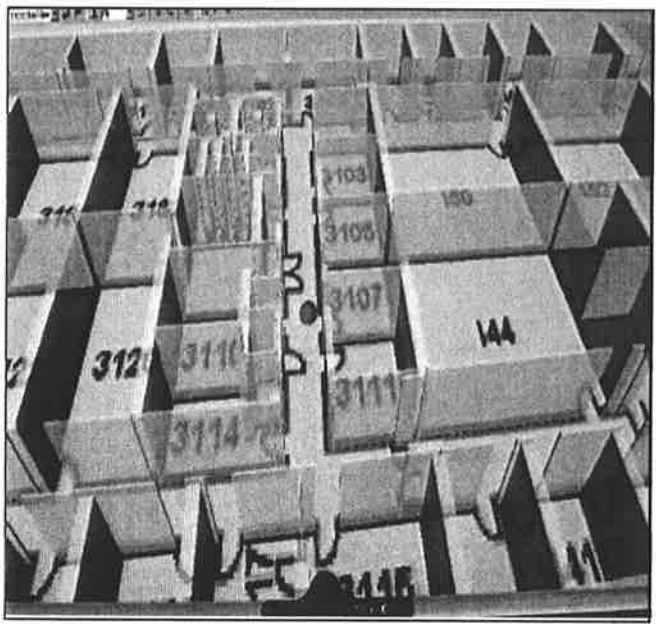


Fig. 39

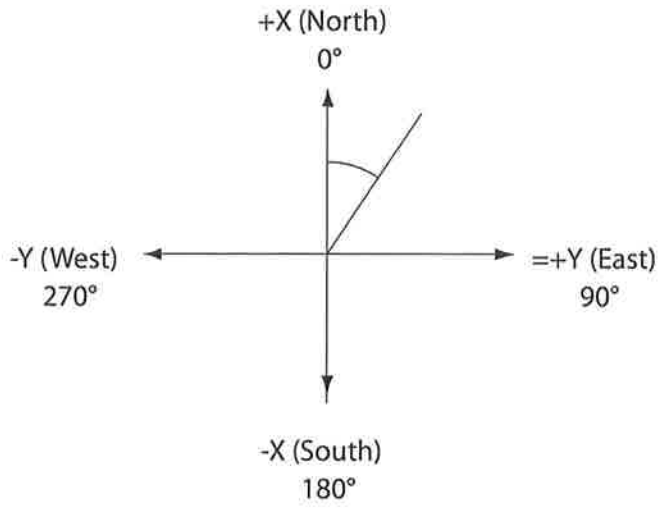

+X (North)
0°
-Y (West)
270°
=+Y (East)
90°
-X (South)
180°

Fig. 40

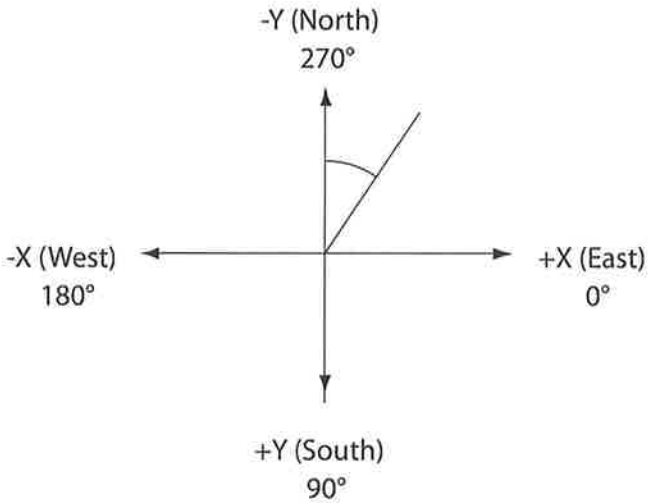

-Y (North)
270°
-X (West)
180°
+X (East)
0°
+Y (South)
90°

Fig. 41

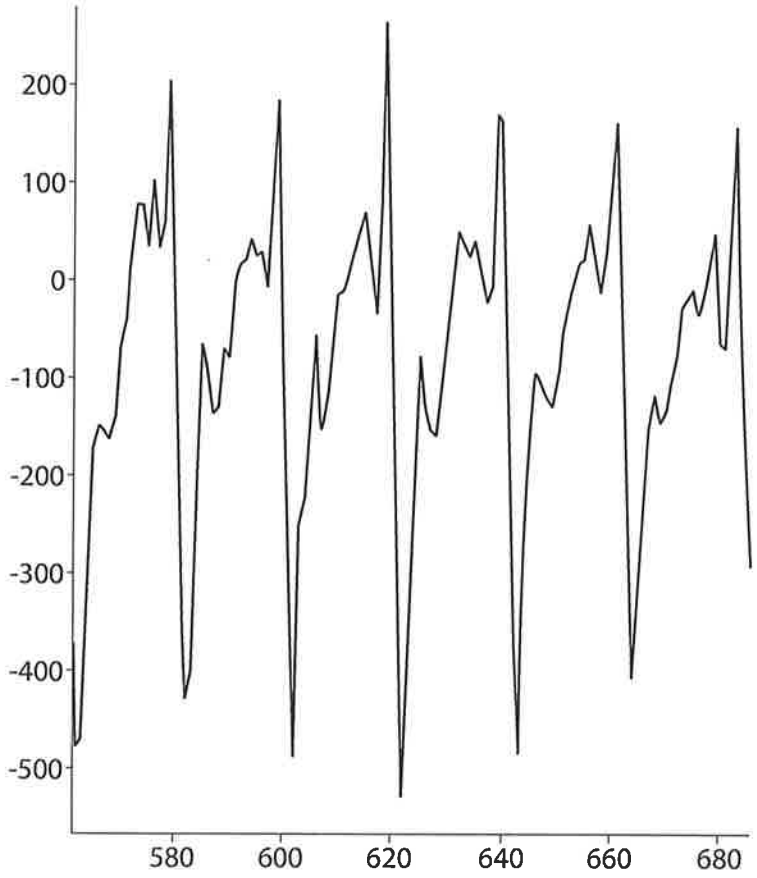


Fig. 42

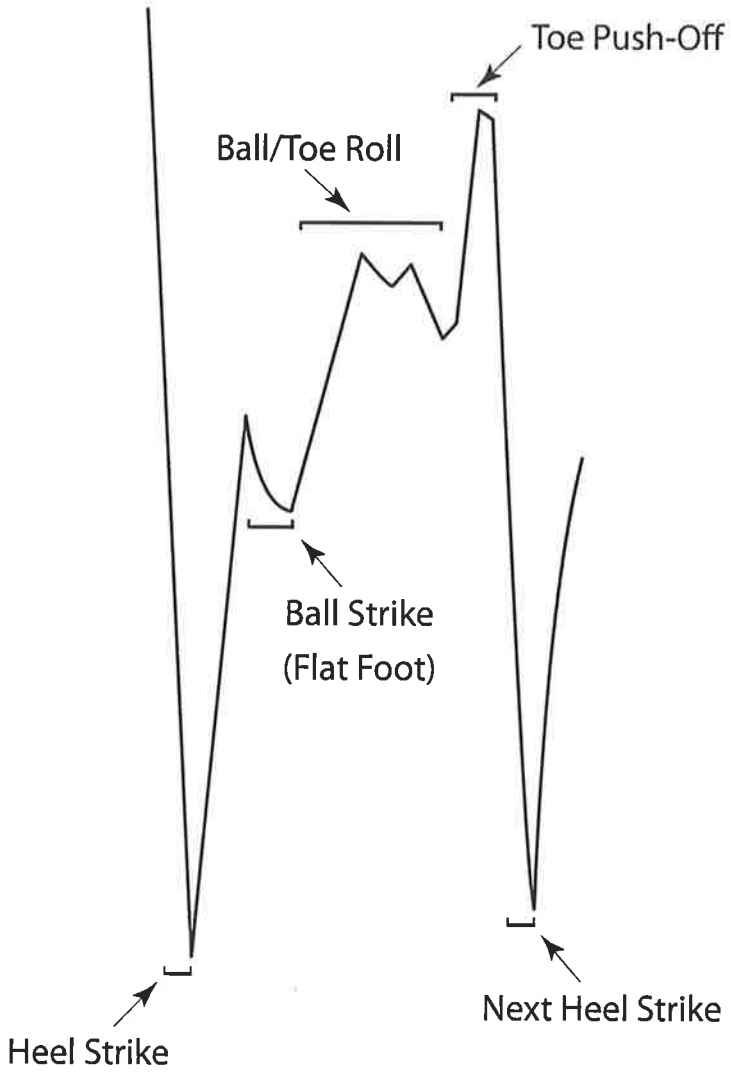

Toe Push-Off
Ball/Toe Roll
Ball Strike
(Flat Foot)
Heel Strike
Next Heel Strike

Fig. 43