SMART HELMET 4.4.08

- LOTS OF RESEARCH ON FIREFIGHTER LOCATION SYSTEMS
  - GPS, AGPS, RF, mesh nodes, etc.
- ON-GOING RESEARCH W/ HEADS-UP DISPLAY TO CONVEY INFORMATION TO FIREFIGHTERS (UC BERKELEY)

→ DEMONSTRATE THESE THINGS, BUT DESIGN SOMETHING MORE SIMPLE & INTUITIVE/PORTABLE/NO SETUP REQUIRED?

- FIREFIGHTERS ARE VERY CLOSE TO THEIR HELMETS
  - IT WOULD BE DIFFICULT TO CHANGE THEIR STYLE
  - DESIGN SYSTEM TO RETROFIT EXISTING HELMETS?

- LASERAID EXIT NAVIGATION SYSTEM, 100mW laser RETROFITTED TO EXIT SIGNS - shown on Discovery Channel

* LASER-BASED FIREFIGHTER IDENTIFICATION UNIT
  - SEE IF FIREFIGHTERS ARE IN ROOM
  - IF SO, LASER COMMUNICATION TO RECEIVE NAME & RANK?

- Personal wearable system for firefighter location

FIREFIGHTER TECH-

PYROPACK

6/7/08

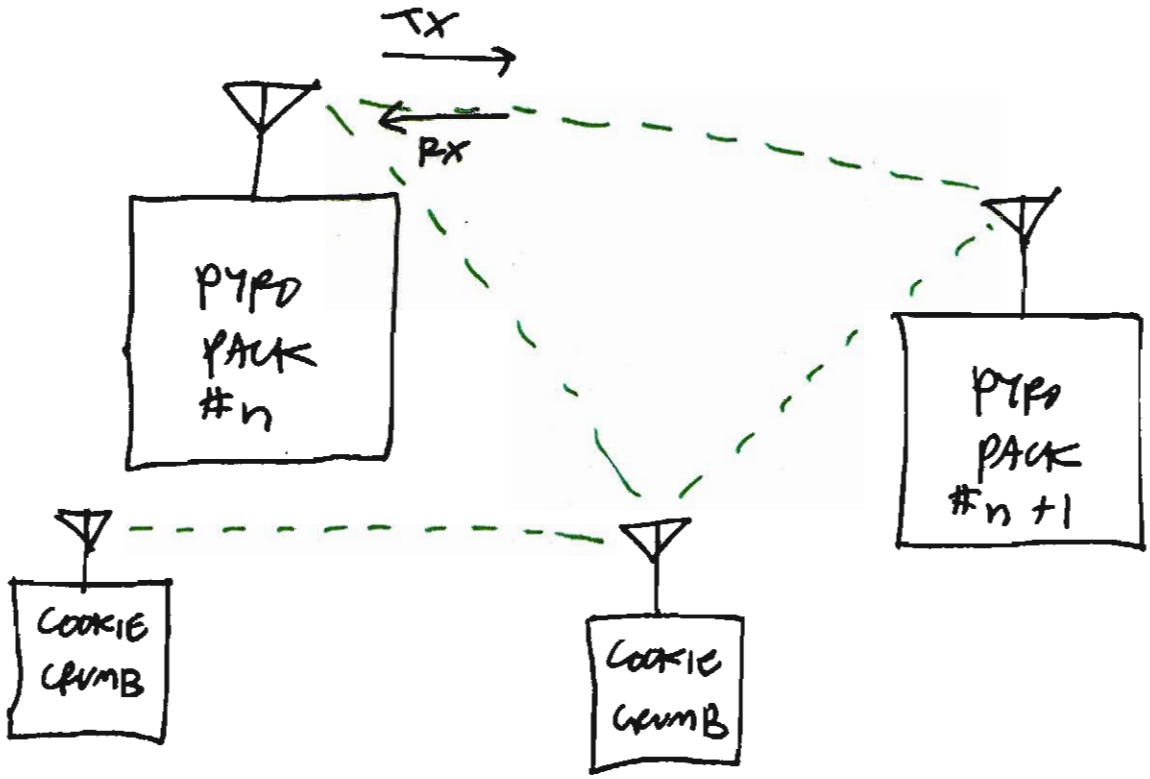
1) -Snag-free back pack
   -Airtank holder & gauge (digital output?)

2) → Heads up display (w/ integrated accelerometer)
   -Thermal camera (move w/ head)

3) → Firefighter ID / ZigBee mesh network
   mayday / all call / cookie crumbs (multiple)
   ↓
   e-mail DiGi

4) -Dry-chem extinguisher

PYRO PACK NETWORK LEVEL DIAGRAM 6/13/08



* EACH NODE ON THE NETWORK TRANSMITS A UNIQUE IDENTIFIER & TEXT/INFORMATION STREAM
  - PYROPACK:
    - NAME
    - RANK
    - ENGINE
    - OXYGEN LEVEL
  - COOKIE CRUMB - MULTIPLE TYPES
    - INGRESS/EGRESS
    - VICTIM INJURED
    - VICTIM DECEASED

* ALL CALL:
  - SYSTEM-LEVEL BROADCAST
  - ALERTS ALL NODES TO EXIT BUILDING ASAP

* MAYDAY:
  - SYSTEM-LEVEL BROADCAST
  - FIREFIGHTER IN DISTRESS
  - TRANSMIT PYROPACK INFO & ALERT

PHONE CALL W/ JORDAN HUSNEY, LEAD ENGINEER 6/18/08

* New "ZB" firmware for XBee: enhanced directional finding
link/RSSI finding

* All units need to be powered up all the time
- CR123A, 1400mAH 3V OK
- 9V + 3.3V REGULATOR OK

* XBee - lower output power v. XBee PRO
≈100 ft. line-of-sight
can attenuate output power for close-range
directional

* Use higher attenuated/directional ANTENNA
- use U.FL connector on XBee module
HIROSE MINI-COAX RF
- can connect extension cable from U.FL to antenna
- DIGI can help source the proper antenna
- lots of stock & good relationships

* XBee has 3 addresses:
1) 802.15.4 - 64-bit globally unique
2) 802.15.4/ZigBee - 16-bit for internal routing
3) XBee-specific - 32 character text ID string
↳ CAN TX NAME, RANK, OR LEVEL

→

XBee - TTL input/outputs:

- Tx SERIAL
- Rx
- /RESET
- SLEEP
- GPIO (4 A/D)

* AT MODE - like modem, for point to point
* API MODE - more access to network internals
  - fully asynchronous
  - need to buffer incoming data & process

FOR DISTANCE MEASUREMENT/SIGNAL STRENGTH:

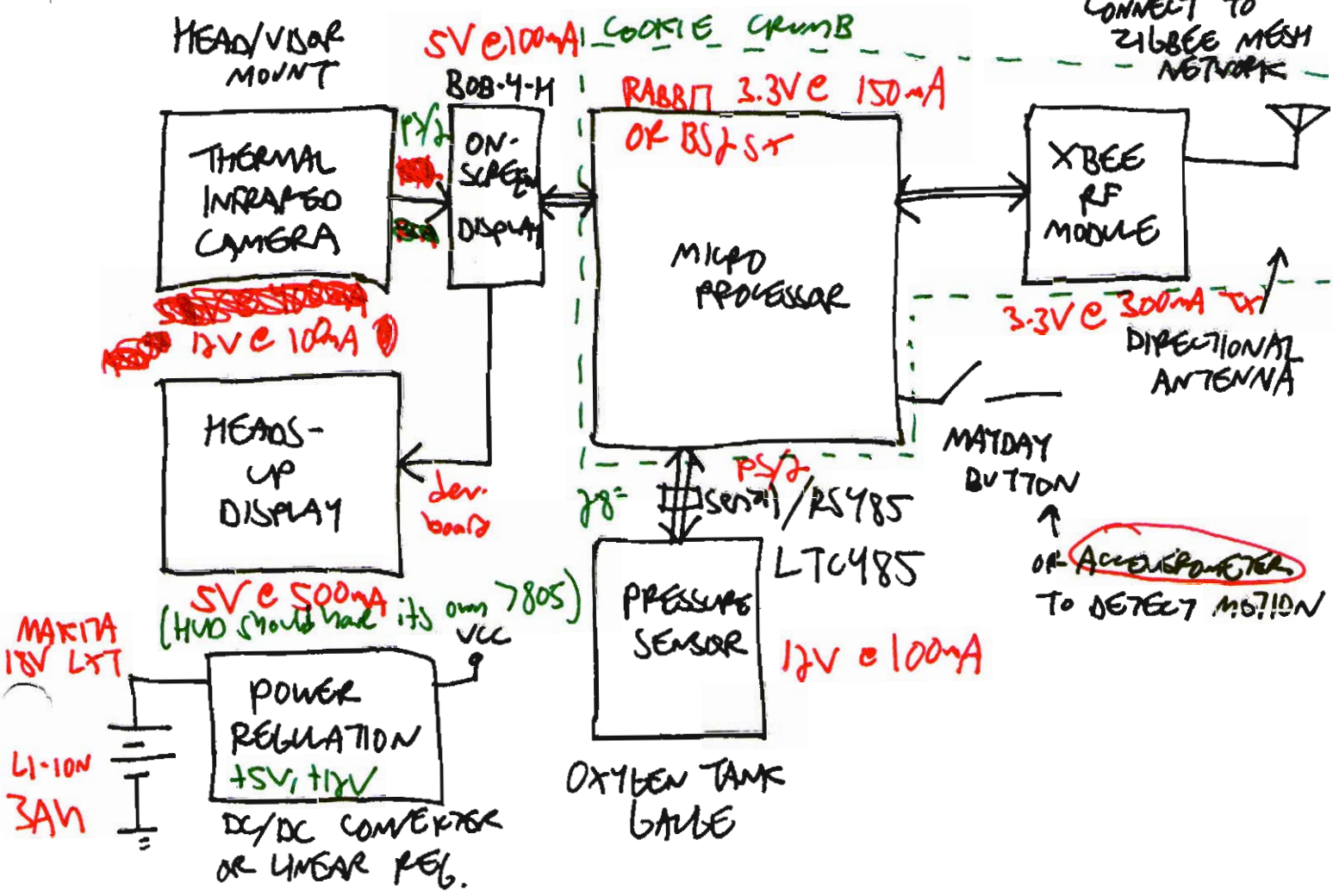
- force node to re-join the network at some interval
  → will update signal strength
- view routing table
  → LQI = "link quality indicator"

COOKIE CRUMB:

- Broadcast mode w/ BASIC Stamp in AT mode?

Jan McBride, Marketing

PYRO PACK SYSTEM BLOCK DIAGRAM 6/12/08



* HEAT RESISTANCE ENVELOPE TO ALLOW OPERATION IN SMOKE/FIRE-FILLED ROOM
  - W.L. GORE OR 3M?

* COOKIE CRUMB - MINIATURED/STRIPPED DOWN VERSION OF FULL PYROPACK
  - JUST MICROPROCESSOR & XBEE MODULE (& SMALL BATTERY) - CR123A
  - .2oz TO DESIGN HOUSING

* LIKE RF "LASER TAG"

- Difficulty of using RF-reflecting
- If it was easy, everyone would do it
- wifi finder example

FACSIMILE

BEYOND

- detect everyone within the room
- use signal strength to find closest person

To _____ Fax number: _____

Date _____ No. of pages _____

From _____ Fax number _____

Subject _____

1) XBEE MODULE, OMNI DIRECTIONAL ANTENNA, series 1 INLINE ATTENUATOR, experiments to figure out how the RSSI varies w/ distance

~~[illegible]~~ connector x3

→ SMA chip antenna x7

- need to operate in far field of antenna
- need to average RSSI to make educated guesses
- exponential moving average to avoid RF phenomenon

2) series 1 or series 2 XBEE - ZIGBEE FOR DATA XFER INDUCTANCE/MAGNETIC FIELD TO DETECT PROXIMITY

- matched coils, limit 0-1.2V for XBee A/D

AKA RFID

periodically monitor circuit

Antenna:
- vertically polarized
- 3 cm radius
- 1/4 antenna, 1 1/2 = high

- SMA - need length from Scott

Beyond Productions Pty Limited
200 California Avenue TREASURE ISLAND CA 94130 USA
Tel: + 1 415 986 8601 FAX: + 1 415 986 8604

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Prototype This! Episode 6: Robotic Firefighter Assistant, Joe Grand's Engineering Development Notes, www.grandideastudio.com

6/24/08

→ ROBERT RIDGEWAY, RF GAWD!x, DIGI
- difficult to determine true direction w/ 2.4GHz due to reflections

- extreme sensitive timing source to discern b/w initial & reflected packets

- XBee module for telemetry

SNR
- Average for 1/2 sec. to get rid of standing wave

star topology
- 15dB SNR for directional

RSSI
- LINK QUALITY INDEX
series 1 802.15.4 module
→ How good is the data link?
- Qualitative assessment for range of person

- No mesh network
- If signal is in range, node hears it
- serial protocol

- Phase information for direction

vs postal service trying to do location tracking

- One receiver, alternate antenna
- phase difference would tell direction
- like having two ears

- Ultrasonic sensors - Swept acoustic
Speed of sound slower
- emit a pulse of sweeping freq.
- all nodes would "record"

Joe - Active
Everyone else - passive

Short near field - may work in small room - turn transmitting way down

- The more data, the better

PYRO PACK OXYGEN TANK PRESSURE GAUGE

4000 psi max.
275.79 bar

PV = nRT

20% remaining = 800 psi = 55.158 bar
50% remaining = 2000 psi = 137.895 bar

* RS232/digital output preferred

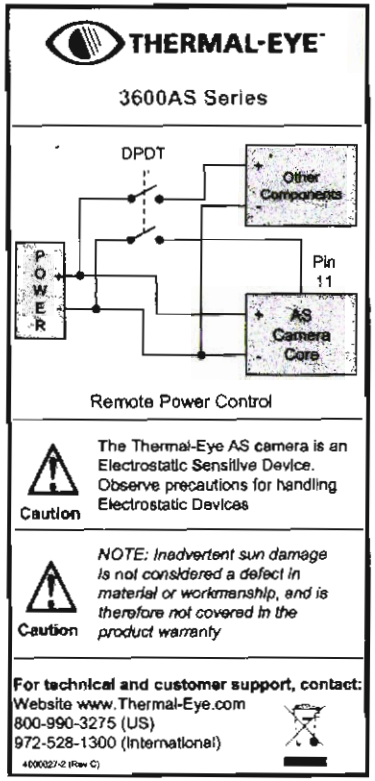
1) KELLER AMERICA, ABOVE GROUND PRESSURE TRANSMITTER
built-to-order
3 day lead
"PRECISE LINE"

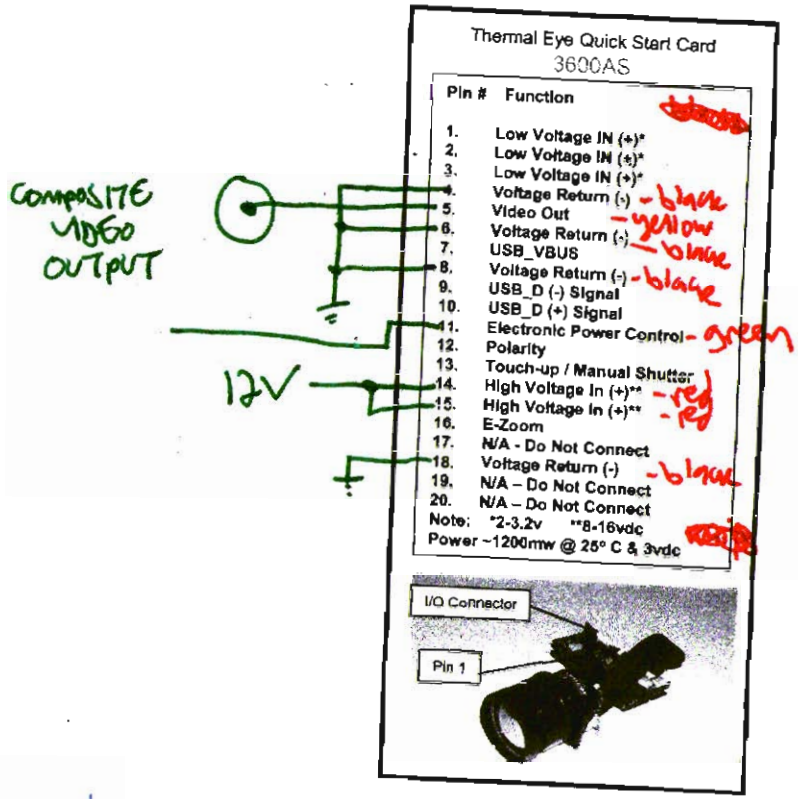
SERIES 33X 0-300 bar
HIGH ACCURACY DIGITAL OUTPUT
877-253-5537
www.kelleramerica.com

JOHN WADLEY 75

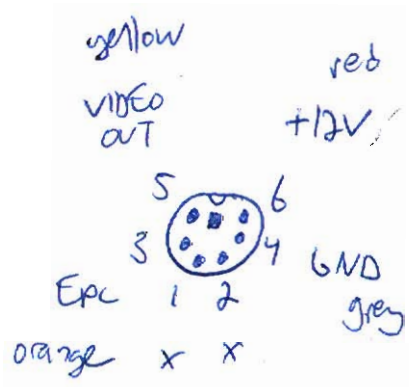
2) MENSOR, SERIES 6000 DIGITAL PRESSURE TRANSDUCER
0-5000 psi or 0-6000 psi
800-984-4200 STEVE, XII, SALES
www.mensor.com

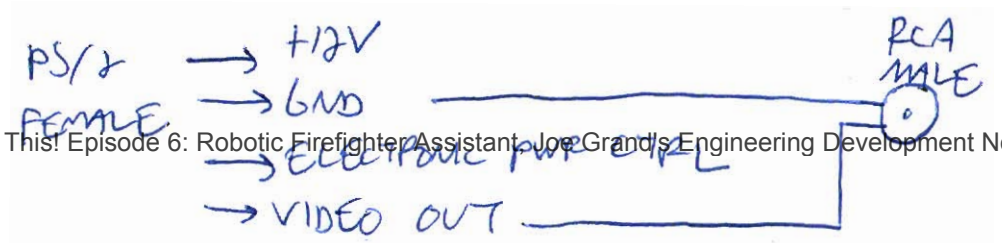
DIN43650
0-4500 psi standard accuracy 0.25% full scale
4-20mA output circuit board (0.1% precise = $65 more)
RS485 digital output
1/4" NPT
~~DIN connector~~ → MIL-C connector
0312.14903.050500.13 $460 + Shipping
Series dwg #/psi accessories lightning protection credit card
Newport News, VA


THERMAL-EYE
3600AS Series
DPDT
Other Components
POWER
Pin 11
AS Camera Core
Remote Power Control
Caution
The Thermal-Eye AS camera is an Electrostatic Sensitive Device. Observe precautions for handling Electrostatic Devices
Caution
NOTE: Inadvertent sun damage is not considered a defect in material or workmanship, and is therefore not covered in the product warranty
For technical and customer support, contact:
Website www.Thermal-Eye.com
800-990-3275 (US)
972-528-1300 (International)


Thermal Eye Quick Start Card
3600AS
Pin # Function
1. Low Voltage IN (+)*
2. Low Voltage IN (+)*
3. Low Voltage IN (+)*
4. Voltage Return (-) - black
5. Video Out - yellow
6. Voltage Return (-) - black
7. USB_VBUS
8. Voltage Return (-) - black
9. USB_D (-) Signal
10. USB_D (+) Signal
11. Electronic Power Control - green
12. Polarity
13. Touch-up / Manual Shutter
14. High Voltage In (+)** - red
15. High Voltage In (+)** - red
16. E-Zoom
17. N/A - Do Not Connect
18. Voltage Return (-) - black
19. N/A – Do Not Connect
20. N/A – Do Not Connect
Note: *2-3.2v **8-16vdc
Power ~1200mw @ 25° C & 3vdc
I/O Connector
Pin 1
COMPOSITE VIDEO OUTPUT
12V

CONNECTOR
CABLE
PS/2
MALE

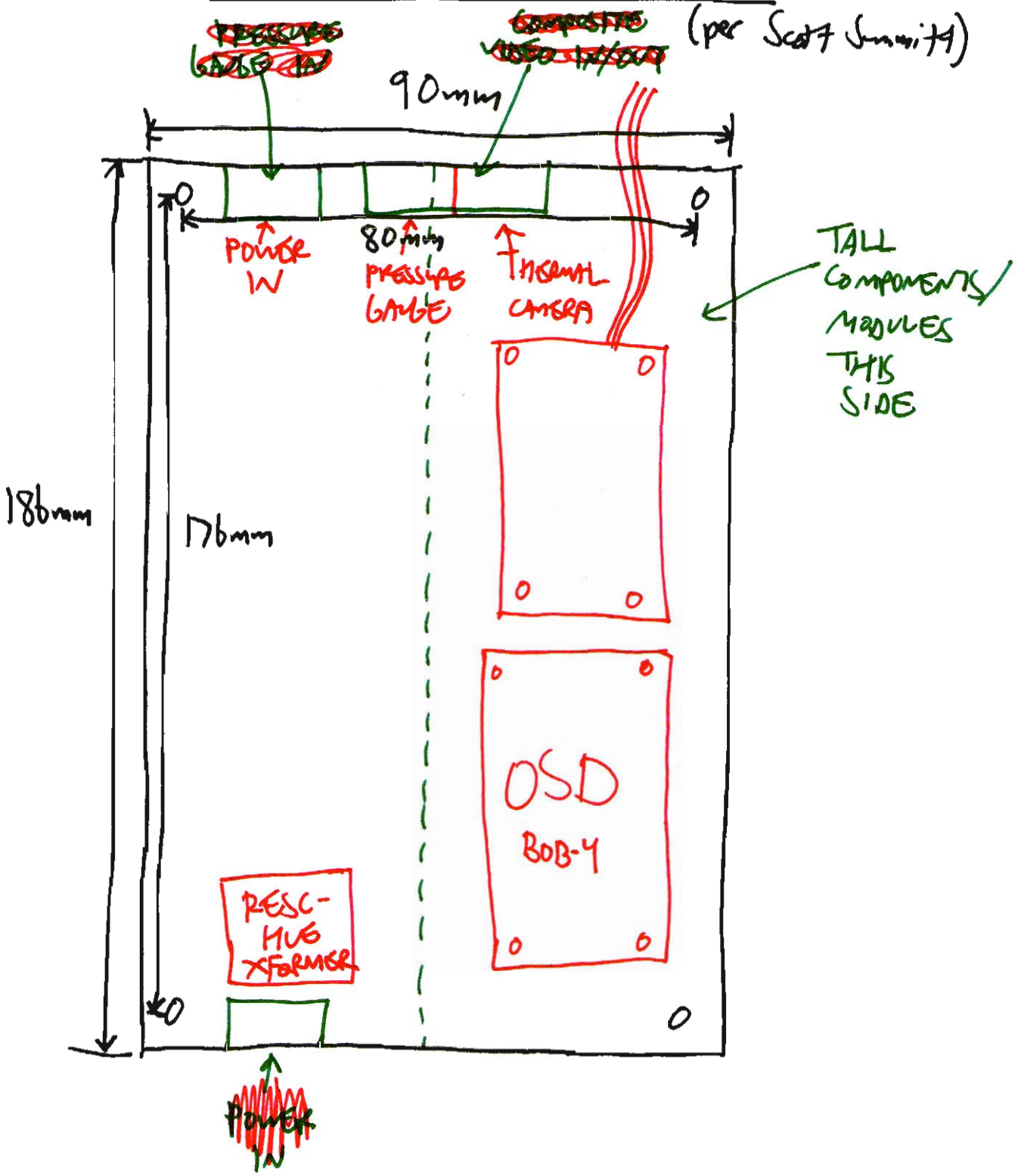

yellow
VIDEO OUT
red
+12V
5
6
3
4
GND
grey
EPC
1
2
orange
x
x


PS/2
FEMALE
+12V
GND
ELECTRONIC PWR CTRL
VIDEO OUT
RCA
MALE

PyroPack PCB Mechanical Outline

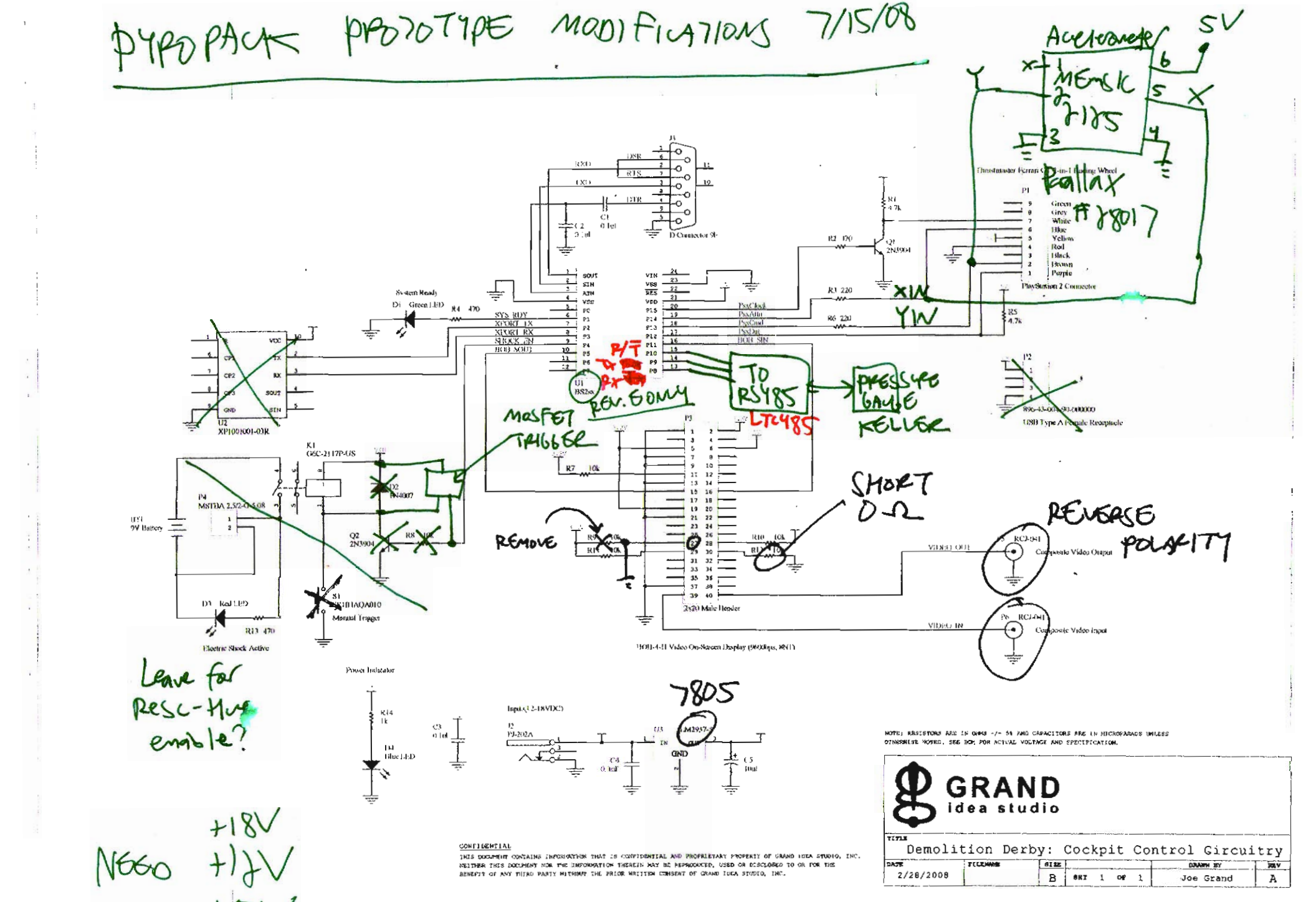
7.14.08

(per Scott Smith)



~25mm typical available height

- taller components to go on right side



NOTE: RESISTORS ARE IN OHMS +/- 5% AND CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE NOTED. SEE BOM FOR ACTUAL VOLTAGE AND SPECIFICATION.

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GRAND idea studio

TITLE					
Demolition Derby: Cockpit Control Circuitry					
DATE	FILENAME	SIZE	SHT 1 OF 1	DRAWN BY	REV
2/28/2008		B		Joe Grand	A

Quantity	Designator	Comment	Value	Description	Footprint	LibRef
4	C1, C2, C5, C6	Cap	0.1uF	Capacitor	VP32-3.2	Cap
2	C3, C7	Cap	0.33uF	Capacitor	VP32-3.2	Cap
2	C4, C8	Cap Pol1	10uF	Polarized Capacitor (Radial)	B	Cap Pol1
1	D1	Green LED		Typical INFRARED GaAs LED	LED	LED0
1	D2	1N4007		1 Amp General Purpose Rectifier	DO-41	Diode 1N4007
3	D3, D4, D5	Blue LED		Typical INFRARED GaAs LED	LED	LED0
1	J1	D Connector 9F		Receptacle Assembly, 9 Position, Right Angle	DSUB1.385-2H9	D Connector 9
1	J2	Comment			2MJ-0104A120	PS/2 (S-VIDEO)
1	J3	2MJ-0104A120			2MJ-0104A120	PS/2 (S-VIDEO)
1	J4	PJ-202A			PJ-202A	PHONEJACK_2
1	K1	G6C-2117P-US			G6C	G6CU-2117P-US
1	P1	RFID Reader		Header, 4-Pin	HDR1X4	Header 4
2	P2, P6	HEADER2-HV		Header, 2-Pin	HEADER2 - HV	Header 2
1	P3	2x20 Male Header		Header, 20-Pin, Dual row	BOB-4-H	Header 20X2
2	P4, P5	RCJ-041		BNC Elbow Connector	RCJ-041	BNC
1	Q1	IRF510		HEXFET N-Channel Power MOSFET	TO-220AB	IRF510
1	R1	Res1	470	Resistor	AXIAL-0.3	Res1
3	R2, R3, R4	Res1	220	Resistor	AXIAL-0.3	Res1
4	R5, R9, R10, R11	Res1	10k	Resistor	AXIAL-0.3	Res1
2	R6, R8	Res1	680	Resistor	AXIAL-0.3	Res1
1	R7	Res1	2.2k	Resistor	AXIAL-0.3	Res1
1	R12	Res1	1k	Resistor	AXIAL-0.3	Res1
1	R13	Res1	3.3k	Resistor	AXIAL-0.3	Res1
1	T1	TECHLITE				TECHLITE
1	U1	MEMSIC2125EB			DIP-6	MEMSIC2125EB
1	U2	BS2sx			DIP24W	BS2
1	U3	LTC485		EIA-485/EIA-422A Differential Bus Transceiver	J08A	DS16F95J/883
1	U4	LM7812		Series 3-Terminal Positive Regulator	T03B	LM7805CT
1	U5	LM7805		Series 3-Terminal Positive Regulator	T03B	LM7805CT

PRESSURE GAUGE

	pascals	HEX
3000 psi MAX =	20,684,272	0x 13B9DFØ
150 psi increments =	1,034,216	0x FC7E8

90%	2850psi	= 17BD6Ø8
85%	2700psi	= 11CØE7Ø
80%	2550psi	= 1ØC4638
75%	2400psi	= FC7E5Ø
70%	2250psi	= ECB668
65%	2100psi	= DCEE8Ø
60%	1950psi	= CD2698
55%	1800psi	= BD5EBØ
50%	1650psi	= AD96C8
45%	1500psi	= 9DCEEØ
40%	1350psi	= 8EØ6F8
35%	1200psi	= 7E3F1Ø
30%	1050psi	= 6E7778
25%	900psi	= 5EAF4Ø
20%	750psi	= 4EE758
15%	600psi	= 3F1F7Ø

450psi = 2F5788 10%

300psi = 1F8FAØ 5%

150psi = FC7B8 Ø%

Ø psi = Ø

STAIR RUNNER/SMART HELMET w/ Bob Kelly 3.28.08

June 2 scheduled SHA

"company" - 3 guys at a time

→ Thermal Imaging Camera = Eagle Imager 160 & Eagle + wireless receiver kit

→ Scott Pak-Tracker Firefighter Locator System
2.4GHz signal strength a/a Man-overboard alert

→ Mini-SA Personal Gas Monitor

- Standard camera to record fire/events

Desired Specifications

CAIRNS BROS. FIREFIGHTER SUPPLY

STANDARD
- Headlight
- Goggle - eye protection Lexan standard
- Nomex neck protection

- Ear protection - only for loud noises/auto response to dB

- Heated shield & identifier to be seen w/ TIC front & back

*MUST TAKE A LOT OF HEAT

- LED (EL light) to identify people in the crew - color coded - IR beacon on helmet for name

- Marker/"course comb" to get out - light bar in rim

- "All call" = trigger - "evacuate" out of the building

- Mayday

Prototype This! Episode 6: Robotic Firefighter Assistant, Joe Grand's Engineering Development Notes, www.grandideastudio.com

②

- Triangulation - where are they in building - ZigBee?
  - Is Tracking w/in a building useful w/o a map of the building?
- Firefighter finder/ID system
- Tracker/who's entered the building
- flip down visor w/ heads-up display
  - In reality, most people don't use the visors
- Chemical/Biological/Radioactive/Explosive Detection
- force on top of helmet - covered force to protect head
- Tagged: victim down/dead
- Temperature sensor/display - know when its too hot or getting too dangerous
  or
  high-heat alarm
  500°F for 5 minutes
- Micro-POV display for TIC

* KNOWING WHO YOU'RE WITH & WHERE YOU'RE GOING

- Close range communications within company

* CAREFUL OF HELMET WEIGHT

4.15.08 JG

FIRETECH: WEARABLE FIRE FIGHTER ID SYSTEM

-Personal, wearable unit for fire fighter in action

* FIRE FIGHTER ID SYSTEM
  - → KNOW WHO SOMEONE IS IN A SMOKE-FILLED ROOM
  - → KNOW WHERE SOMEONE IS → PREFERABLY DIRECTIONAL?
    - -RF - ZIGBEE?
    - -ULTRASONIC
    - -IR LED
    - -LASER

→ DISPOSABLE BEACONS FOR:
- -DOORWAY/EGRESS IDENTIFICATION "cookie crumbs"
- -TRIAGE/VICTIM DOWN/VICTIM DEAD
- -ACTIVE RFID TAGS?

→ "ALL CALL" TRIGGER TO ALERT FIREFIGHTER TO GET OUT OF BUILDING ASAP
- -audio, visual, vibration

→ AMBIENT TEMPERATURE ALARM — KNOW WHEN IT'S TOO HOT OR TOO DANGEROUS 500°F FOR 5 min.?

* ARM MOUNTED?
* VFD (VACUUM FLUORESCENT DISPLAY) HIGH BRIGHTNESS
* NOISE-CANCELLING HEADPHONE OR IN-EAR MONITOR (ONE EAR)?
  - SPEECH SYNTHESIS VIA EMIC MODULE FOR VOICE/SPOKEN INFORMATION (also displayed on VFD)

Super Backpack — S/[illegible] — lots of noise & lots of confusion

- Battery power
- framework for electronics
  - vibrator/poker for all call/mayday

- Display - image of person
  or - info

Jesse - heads-up display — thermal camera image w/ text overlay
- mask or helmet

RID

- Mask is tethered to backpack in normal use

- Quick bottle change

- Ruggedized - no snag
  need a switch

Resc-hose

Mayday

- Firefighter ID / all call / cookie cumulus for triage
- Thermal imaging w/ "predator"

- power-on when clipped
- air tank % remaining

SECRET: - dry-chem holder in backpack - 1 gallon = 8 lbs water
- void protection to prevent bottles from snagging on wires
  snag-free

NFPA
~~[illegible]~~
OSHA

- "PASS" Personal Alert Safety System
  - alert if no movement for 30 sec.
  - alert if low air

Prototype This! Episode 6: Robotic Firefighter Assistant, Joe Grand's Engineering Development Notes, www.grandideastudio.com

- A snag free air tank pack. Fire fighters often get their tanks snagged on wires or cables when crawling through tight spaces and have to cut themselves free.
- A heads up display that can show info about each fire fighter. Name and oxygen level.
- A tagging system based on the same zigbee-networking tech used to id each fire fighter that will allow fire fighters to quickly tag rooms and or victims as they move through a building. Other fire fighters can then identify rooms that are cleared and victims in need of assistance.
- A thermal imaging camera mounted Predator style to the fire fighters shoulder and displayed on their heads up display.
- A dry-chem extinguisher built into the pack and fired from the wrist like SpiderMan.
- An all call mayday that will alert Fire Fighters to exit the building quickly.
- All hardware is mounted inside the custom snag free tank pack.
- Bob Kelly's lifeline mounted to the bottom of our Pyro Pack will guide Fire Fighters out of the building.

SCOTT SUMMIT - PACK DESIGN

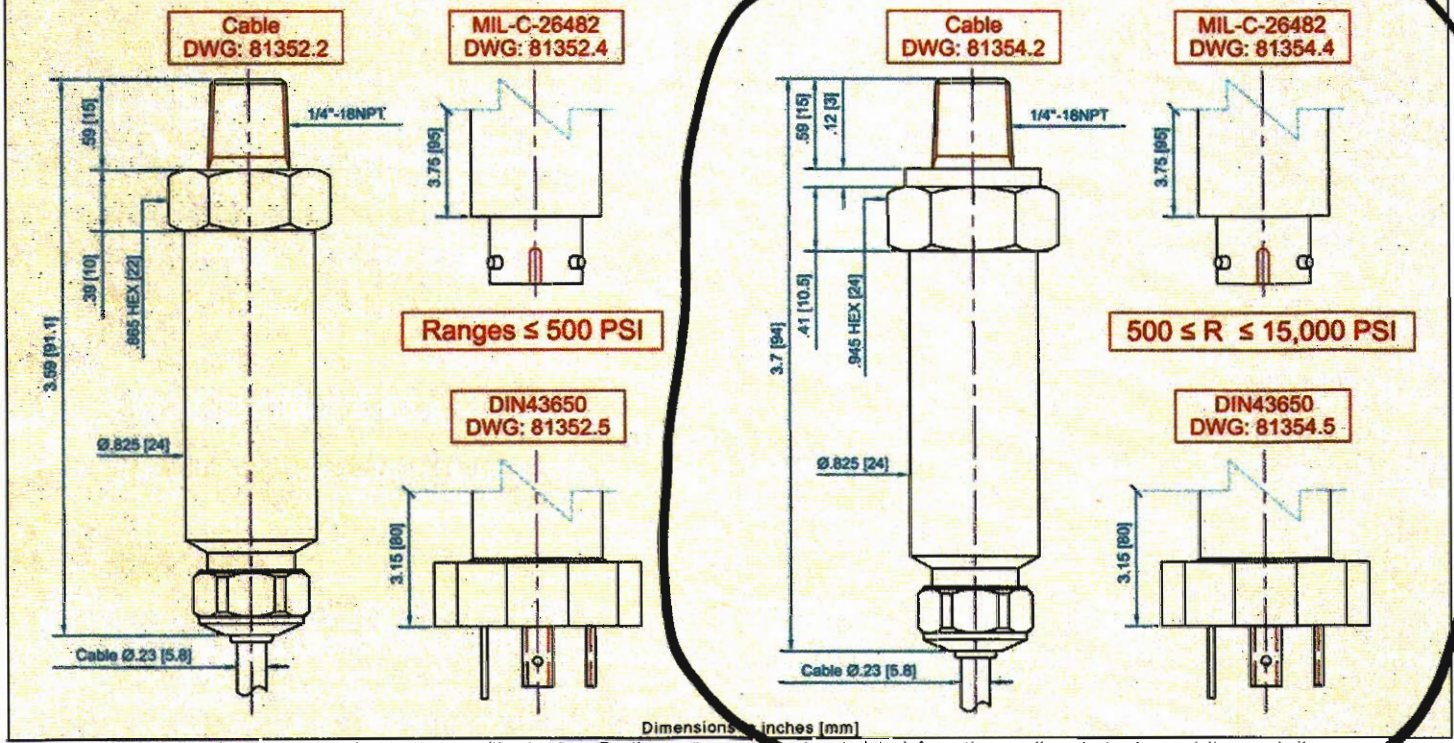
Preciseline

Specifications

Pressure units	PSIG	PSIA	PSIS[1]
Pressure Range (user specified)	Infinite from 0–2 thru 0–500	Infinite from 0–2 thru 0–500	Infinite from 0–500 thru 0–15,000
Zero Point	*Note 2*	*Note 1*	*Note 1*
Proof Pressure	Varies by range, from 10X for 1PSI to 1.1X for 15,000 PSI.		
Supply[5]	*VDC*	8 – 28	13 – 28
Output	~~*2 wire analog*~~	~~4 – 20 mA~~	
	~~*3 wire analog*~~	~~0 – 5 VDC~~	0 – 10 VDC
	4 wire digital	RS485	
Electrical Connection	Standard: 5ft Hytrel-jacketed shielded cable or DIN43650 connector[3] Optional: MIL-C-26482 connector[4]		

Accuracy, T.E.B.[6]	Standard: ±0.2% Optional: ±0.1%
Compensated temp. range	-10 – 80°C
Operating temp. range	-40 – 120°C
Process Connection	1/4 NPT male
Wetted materials	316L SS, Fluorocarbon
Environmental protection	IP65
CE-Conformity	EN50081-1, EN50082-2
Shock	20g (11ms)
Vibration	20g (5 – 2KHz, max. amp. ±3mm) per IEC68-2-6

Dimensions



Dimensions in inches [mm]

Note. Dimensions & specifications are subject to change without notice. For the most accurate and up to date information on all products please visit our website.

Wiring Configuration

Configuration[7,8]	Pin 1 / C / ~~Wire~~	Pin 2 / ~~B~~ / Red	Pin 3 / A / ~~Black~~	D / ~~Blue~~	F / ~~Yellow~~
2 Wire (mA)	OUT / GND		+Vcc	RS485A	RS485B
3 Wire (VDC)	GND	+OUT	+Vcc	RS485A	RS485B
4 Wire (RS485 Only)	GND		+Vcc	RS485A	RS485B

Yellow Blue Grey White

Notes:

1. PSIG = Gage; Zero-point referenced to local atmospheric pressure
   PSIA = Absolute; Zero-point set at hard vacuum
   PSIS = Sealed Gage, Zero-point set at 1 bar absolute (14.504 PSIA).
2. Zero-point can be suppressed or elevated for special applications

PS/2: #2

3. Mating connector supplied at no extra cost. Does not support RS485.
4. At extra cost, includes mating connector
5. Lower supply operation possible with RS485 output only. Consult factory for details.
6. TEB: Total Error Band; Includes the combined effects of non-linearity, hysteresis and non-repeatability as well as thermal dependencies, over the compensated temperature range, expressed as a percentage of the Basic Range. All intermediate ranges are realized by deranging from standard Basic Ranges of 15, 45, 150, 450, 1500, 4500, 14500 PSI
7. Pins 1, 2 & 3 refer to the DIN style connector. A, B, C .. refer to the MIL style connector, and colors refer to the wires inside the cable.
8. The drain / shield is connected to the transmitter housing. For best protection against galvanic corrosion, do not ground.

KELLER AMERICA, INC.
813 Diligence Drive, Suite 120 • Newport News, VA 23606 • Toll Free (877) 2-KELLER • Phone (757) 596-6680 • Fax (757) 596-6659
USA: www.keller-america.com • Switzerland: www.keller-druck.com

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HEX DECIMAL

01, 30, 34, 00 (48) — INITIALIZE

01, 1E, 50, 9C, 29 (30 80) — READ COEFFICIENT: MINIMUM PRESSURE

01, 1E, 51, 5C, E8 (30 81) — READ COEFFICIENT: MAXIMUM PRESSURE

01, 45, D3, C1 (69) — READ SERIAL #

01, 49, 01, 50, D6 (73) — READ PRESSURE SENSOR #1 (bar)

Prototype This: Episode 6: Robotic Firefighter Assistant, Joe Grand's Engineering Development Notes, www.grandideastudio.com