International Rectifier

IPS6044GPbF

INTELLIGENT POWER HIGH SIDE SWITCH

Features

- Over temperature shutdown (with auto-restart)
- Short circuit protection (current limit)
- Reverse battery protection (turns On the MOSFET)
- Full diagnostic capability (short circuit to battery)
- Active clamp
- Open load detection in On and Off state
- Ground loss protection
- Logic ground isolated from power ground
- ESD protection

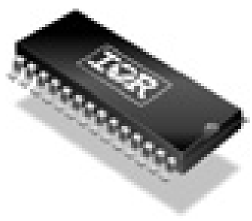
Product Summary

Rds(on)	130mΩ max.
Vclamp	39V
I Limit	7A
Open load	3V / 0.22A

Description

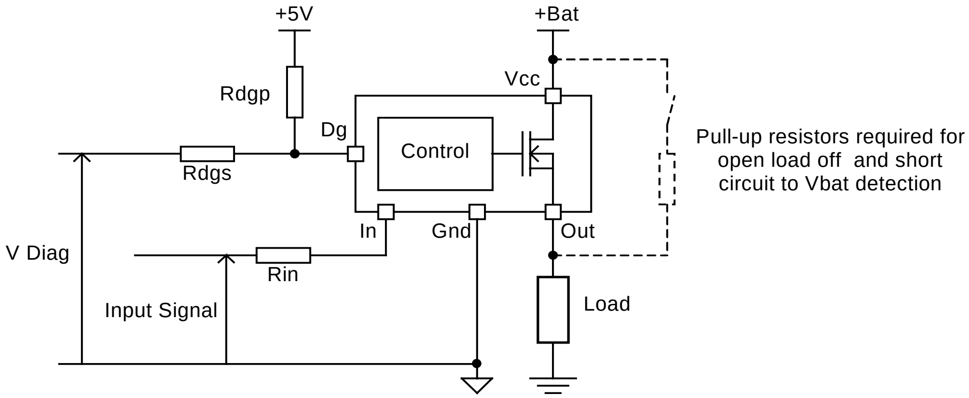
The IPS6044GPbF is quad output Intelligent Power Switch (IPS) for use in a high side configuration. It features short circuit, over-temperature, ESD protection, inductive load capability and diagnostic feedback. The output current is limited to the Ilim value. The current limitation is activated until the thermal protection acts. The over-temperature protection turns off the device if the junction temperature exceeds the Tshutdown value. It will automatically restart after the junction has cooled 7°C below the Tshutdown value. The reverse battery protection turns On the MOSFET. A diagnostic pin provides different voltage levels for each fault condition. The double level shifter circuitry will allow large offsets between the logic and load ground.

Package



SO28 Wide body

Typical Connection



Qualification Information†

Qualification Level		Automotive (per AEC-Q100††)	
		Comments: This family of ICs has passed an Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		SOIC28W	MSL2, 260°C (per IPC/JEDEC J-STD-020)
ESD	Machine Model	Class B (per JEDEC standard JESD22-A115)	
	Human Body Model	Class 1C (per EIA/JEDEC standard EIA/JESD22-A114)	
RoHS Compliant		Yes	

† Qualification standards can be found at International Rectifier's web site http://www.irf.com/

†† Exceptions to AEC-Q100 requirements are noted in the qualification report.

Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to Ground lead. (Tambient=25°C unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
Vout	Maximum output voltage	Vcc-35	Vcc+0.3	V
Voffset	Maximum logic ground to load ground offset	Vcc-35	Vcc+0.3	V
Vin	Maximum input voltage	-0.3	5.5	V
Vcc max.	Maximum Vcc voltage	—	36	V
Vcc cont.	Maximum continuous Vcc voltage	—	28	V
Iin max.	Maximum IN current	-3	10	mA
Idg max.	Maximum diagnostic output current	-3	10	mA
Vdg	Maximum diagnostic output voltage	-0.3	5.5	V
Pd	Maximum power dissipation (internally limited by thermal protection) Rth=130°C/W per channel	—	3.8	W
ESD	Electrostatic discharge voltage (Human body) C=100pF, R=1500Ω — Between In and Vcc	—	1500	V
	Electrostatic discharge voltage (Human body) C=100pF, R=1500Ω — Other combinations	—	4000	V
	Electrostatic discharge voltage (Machine Model) C=200pF,R=0Ω,L=10µH — Between In and Vcc	—	100	V
	Electrostatic discharge voltage (Machine Model) C=200pF,R=0Ω,L=10µH — Other combinations	—	500	V
Tj max.	Max. storage & operating temperature junction temperature	-40	150	°C
Tsoldering	Soldering temperature (10 seconds)	—	300	°C

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
Rth1	Thermal resistance junction to ambient 1" sqrt. Footprint / 1 channel On	50	—	°C/W
Rth2	Thermal resistance junction to ambient 1" sqrt. Footprint / 2 channels On	100	—	°C/W
Rth3	Thermal resistance junction to ambient 1" sqrt. Footprint / 4 channels On	130	—	°C/W

note : Tj=Power dissipated in one channel x Rth

Recommended Operating Conditions

These values are given for a quick design. For operation outside these conditions, please consult the application notes.

Symbol	Parameter	Min.	Max.	Units
VIH	High level input voltage	4	5.5	
VIL	Low level input voltage	0	0.9	
Iout	Continuous drain current, Rth=130°C/W, Tj=150°C, 4 channels On — Tambient=85°C / 1" sqrt. footprint	—	1.5	A
	Continuous drain current, Rth=130°C/W, Tj=150°C, 4 channels On — Tambient=105°C / 1" sqrt. footprint	—	1.2	A
Rin	Recommended resistor in series with IN pin	4	10	kΩ
Rdgs	Recommended resistor in series with DG pin for reverse battery protection	4	20	kΩ
Rdgp	Recommended pull-up resistor for DG	4	20	kΩ
Rol	Recommended pull-up resistor for open load detection	5	100	kΩ
F max.	Max. switching frequency	—	3.5	kHz

Static Electrical Characteristics

Tj=25°C, Vcc=14V (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Rds(on)	ON state resistance Tj=25°C	—	110	130	mΩ	Vin=5V, Iout=2.5A
	ON state resistance Tj=150°C(1)	—	190	230		Vin=5V, Iout=2.5A
	ON state resistance Tj=25°C, Vcc=6V	—	125	155		Vin=5V, Iout=1.5A
	ON state resistance during reverse battery	—	140	180		Vcc-Gnd=14V
Vcc op.	Operating voltage range	6	—	28	V	
V clamp 1	Vcc to Out clamp voltage 1	37	39	—		Iout=20mA
V clamp 2	Vcc to Out clamp voltage 2	—	40	42		Iout=2.5A (see Fig. 1)
Icc Off	Supply current when Off	—	4	9	µA	Vin=0V, Vout=0V
Icc On	Supply current when On	—	2.2	5	mA	Vin=5V
Vih	Input high threshold voltage	—	2.5	2.9	V	
Vil	Input low threshold voltage	1.5	2	—		
In hyst.	Input hysteresis	0.2	0.5	1		
Iin On	Input current when device is On	—	45	100	µA	Vin=5V
Idg	Dg leakage current	—	0.1	10		Vdg=5V
Vdg	Low level DG voltage	—	0.25	0.4	V	Idg=1.6mA

Switching Electrical Characteristics

Vcc=14V, Resistive load=6Ω, Vin=5V, Tj=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tdon	Turn-on delay time	—	5	15	µs	see Fig. 3
Tr1	Rise time to Vout=Vcc-5V	—	3	10		
Tr2	Rise time to Vout=0.9 x Vcc	—	4	20		
dV/dt (On)	Turn On dV/dt	—	2.5	5	V/µs	
EOn	Turn On energy	—	100	—	µJ	
Tdoff	Turn-off delay time	—	10	20	µs	
Tf	Fall time to Vout=0.1 x Vcc	—	3	10		
dV/dt (Off)	Turn Off dV/dt	—	6.5	20	V/µs	
EOff	Turn Off energy	—	50	—	µJ	

Protection Characteristics

Tj=25°C, Vcc=14V (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ilim	Internal current limit	4	7	10	A	Vout=0V
Tsd+	Over temperature high threshold	150(1)	165	—	°C	See fig. 2
Tsd-	Over temperature low threshold	—	158	—		
Vsc	Short-circuit detection voltage(2)	2	3	4	V	
UV		—	5	5.9		
UV hyst.		0.25	—	1.6		
VOL Off	Open load detection threshold	2	3	4		
I OL On	Open load detection threshold	0.05	0.15	0.22	A	

(1) Guaranteed by design
(2) Reference to Vcc

True Table

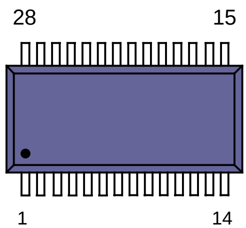
Operating Conditions	IN	OUT	DG
Normal	H	H	H
Normal	L	L	H
Open Load	H	H	L
Open Load (3)	L	H	L
Short circuit to Gnd	H	L	L
Short circuit to Gnd	L	L	H
Short circuit to Vcc	H	H	L (4)
Short circuit to Vcc (5)	L	H	L
Over-temperature	H	L	L
Over-temperature	L	L	H

(3) With a pull-up resistor connected between the output and Vcc.
(4) Vds lower than 10mV.
(5) Without a pull-up resistor connected between the output and Vcc.

Lead Assignments

1- Vcc
2- GND1
3- IN1
4- DG1
5- DG2
6- IN2
7- GND2
8- GND3
9- IN3
10- DG3
11- DG4
12- IN4
13- GND4
14- VCC

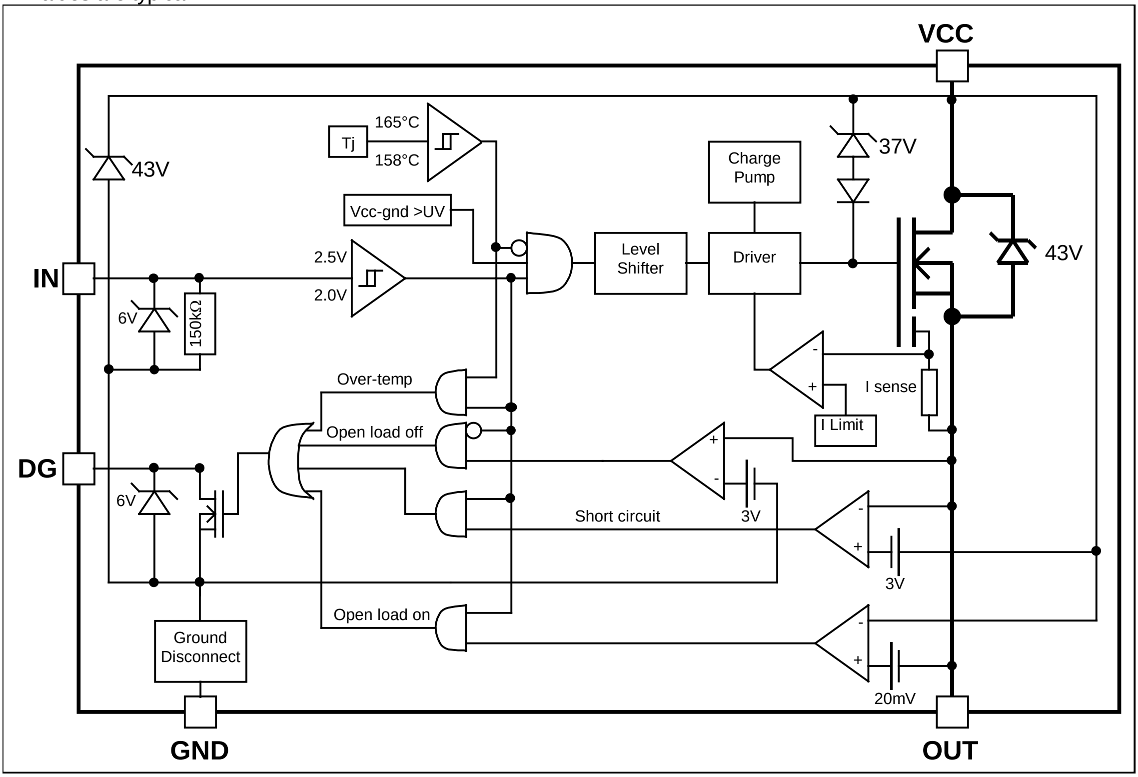
15- Vcc
16- OUT4
17- OUT4
18- OUT4
19- OUT3
20- OUT3
21- OUT3
22- OUT2
23- OUT2
24- OUT2
25- OUT1
26- OUT1
27- OUT1
28- Vcc

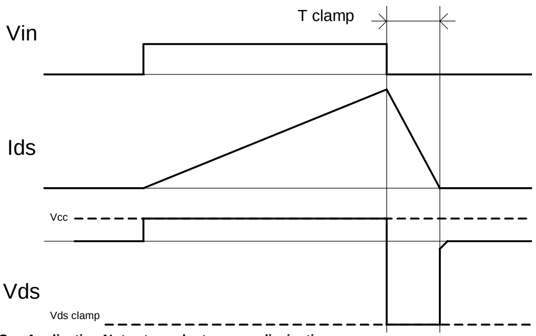


SO28

Functional Block Diagram

All values are typical





See Application Notes to evaluate power dissipation

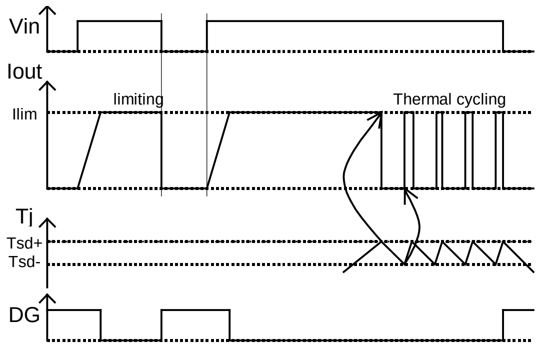
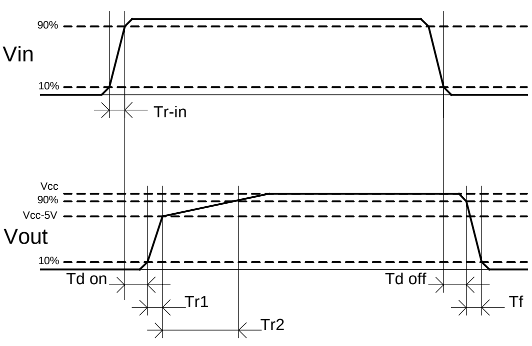


Figure 1 – Active clamp waveforms

Figure 2 – Protection timing diagram



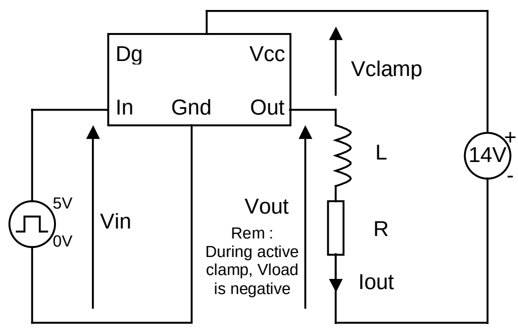


Figure 3 – Switching times definitions

Figure 4 – Active clamp test circuit

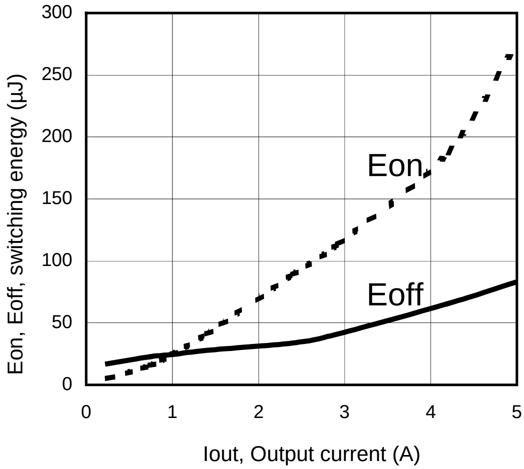


Figure 5 – Switching energy (µJ) Vs Output current (A)

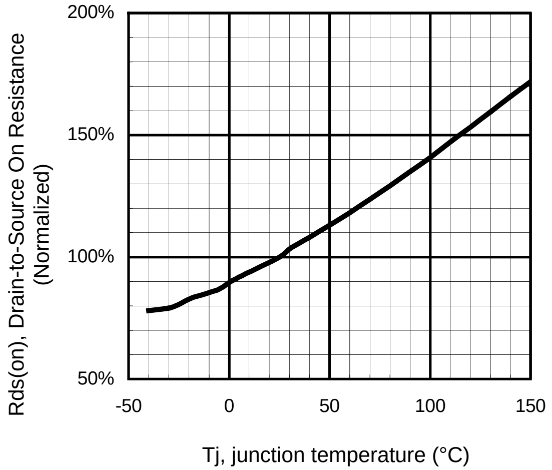


Figure 6 - Normalized Rds(on) (%) Vs Tj (°C)

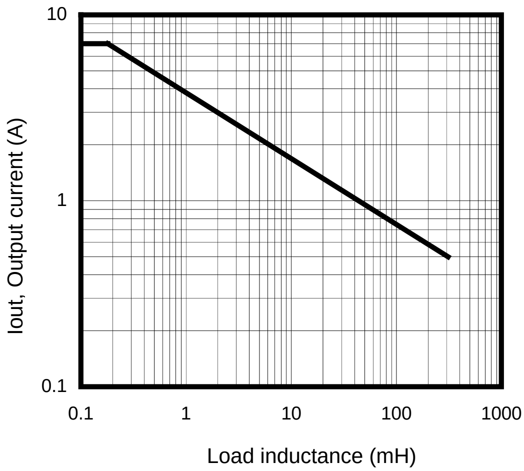


Figure 7 – Max. Output current (A) Vs Load inductance (mH)

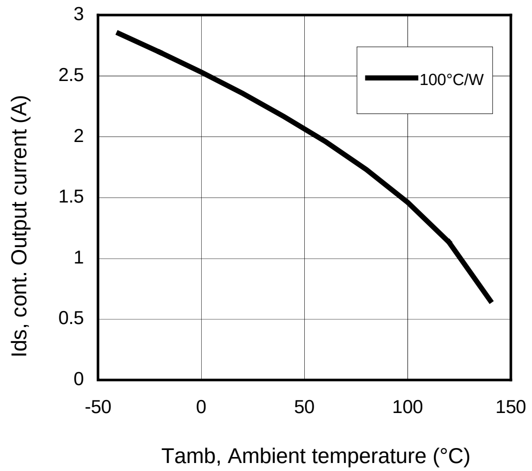


Figure 8 – Max. ouput current (A) Vs Ambient temperature (°C)

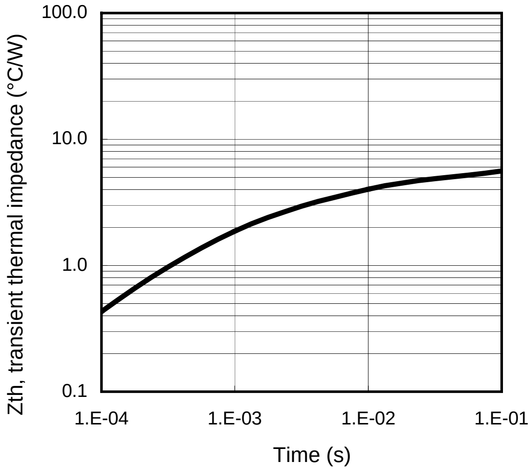


Figure 9 – Transient thermal impedance (°C/W) Vs time (s)

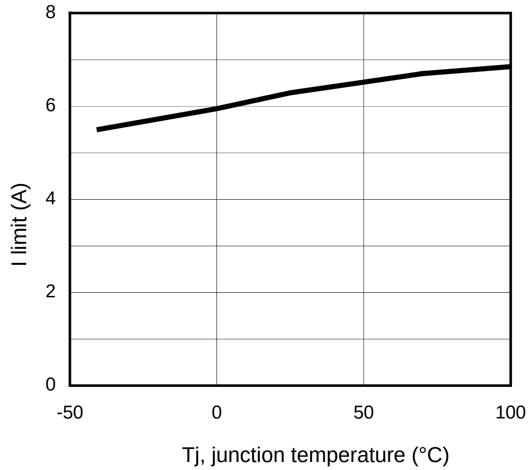


Figure 10 –I limit (A) Vs junction temperature (°C)

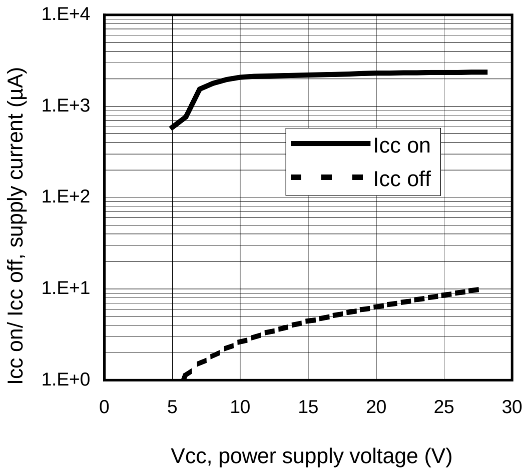


Figure 11 – Icc on/ Icc off (µA) Vs Vcc (V)

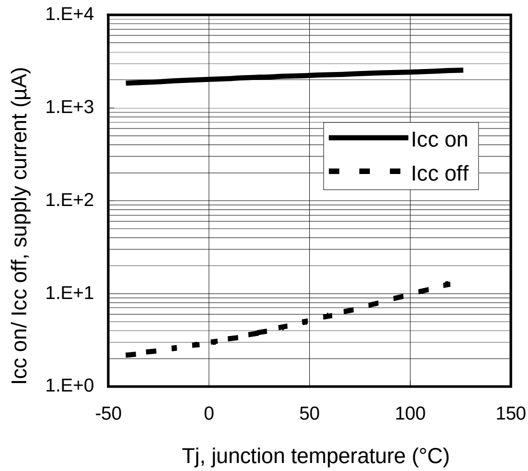
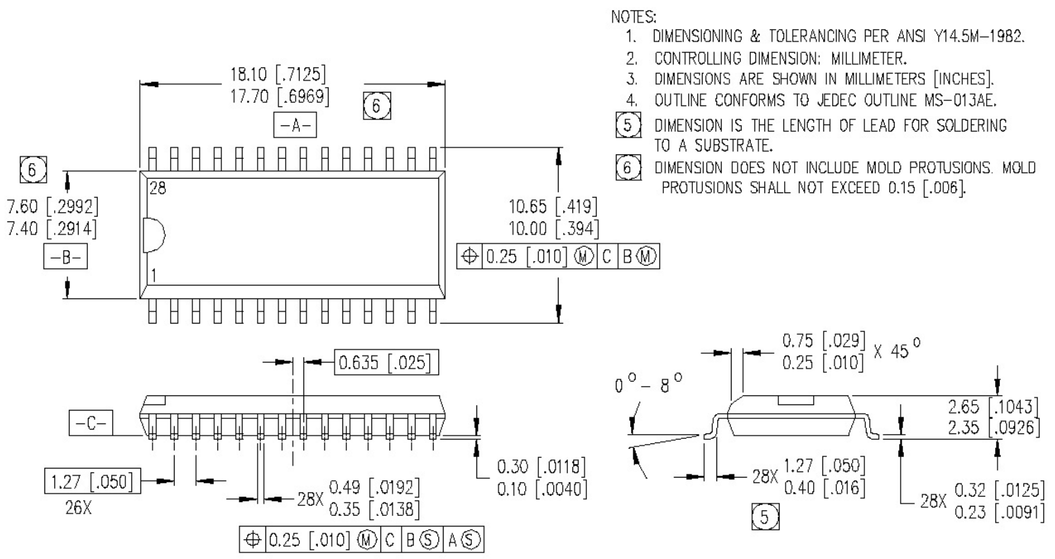


Figure 12 – Icc on/ Icc off (µA) Vs Tj (°C)

Case Outline – SO28



28 Lead SOIC (wide body)

For technical support, please contact IR's Technical Assistance Center
http://www.irf.com/technical-info/

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Tel: (310) 252-7105

Revision History

Revision	Date	Notes/Changes
A	25/04/08	First release