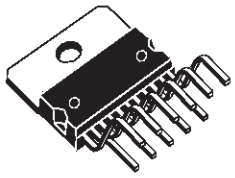
L4948

QUAD VOLTAGE REGULATOR WITH INHIBIT AND RESET

- 4 OUTPUTS: 10V (300mA); 8V (400mA); 5V (600mA); 5V (100mA)
- ALL FOUR OUTPUTS ARE LOW DROP
- 5V (100mA) ST-BY OUTPUT VOLTAGE
- EARLY WARNING OUTPUT FOR SUPPLY UNDERVOLTAGE (LVW)
- THERMAL SHUTDOWN AND CURRENT LIMITATION (FOLDBACK)
- REVERSE BATTERY AND LOAD DUMP PROTECTION
- INHIBIT (ON/OFF) AND RESET FUNCTIONS

MULTIPOWER BCD TECHNOLOGY



Multiwatt 11

ORDERING NUMBER: L4948

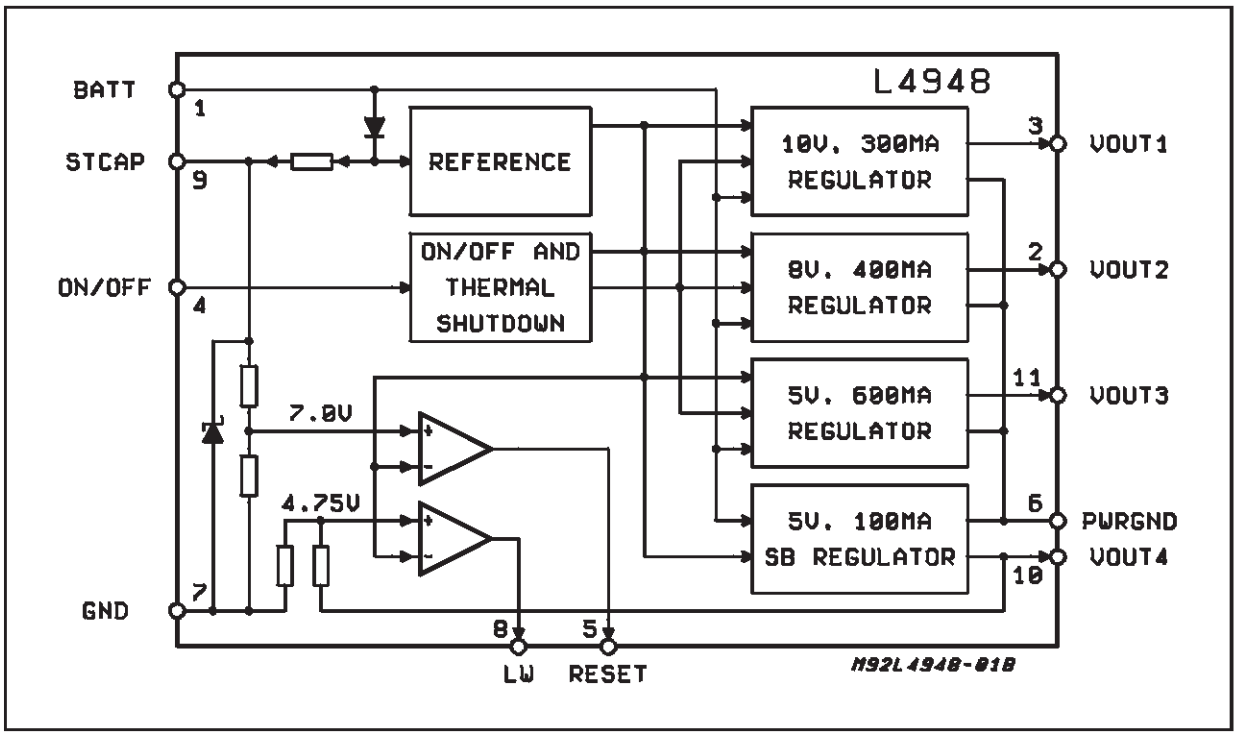
DESCRIPTION

The L4948 is a quad output low drop voltage regulator. All four outputs are low drop: 10V at 300mA (V_{O1}), 8V at 400mA (V_{O2}), 5V at 600mA (V_{O3}) and a 5V st-by line at 100mA (V_{O4}).

The IC includes a monitoring circuit to warn if a low voltage or no voltage condition is occurring. $V_{O1,2,3}$ are off during st-by mode.

The STCAP pin allows the battery voltage to decay slowly giving the µP time to store data. This IC is designed for supplying microcomputer controlled systems specially in automotive applications.

BLOCK DIAGRAM



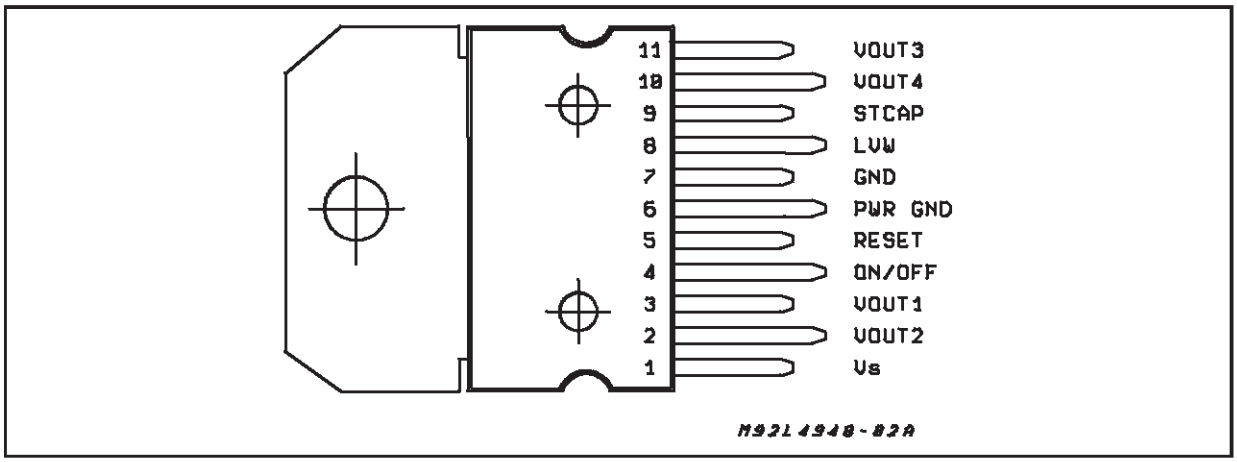
OPERATING CONDITION

Symbol	Parameter	Value	Unit
V_S	Supply Voltage	-15 to 27	V
I_L	Load Current I_{O1}	300	mA
	I_{O2}	400	mA
	I_{O3}	600	mA
	I_{O4}	100	mA

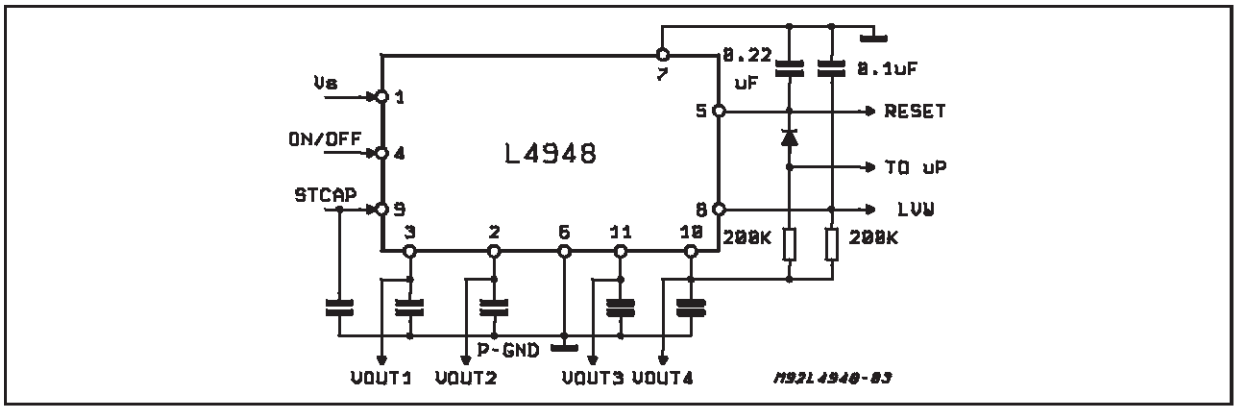
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	Supply Voltage	-35 to 60	V
V_I	Input Voltage (ON/OFF)	0 to 12	V
V_O	Output Voltage (LVW, Reset)	0 to 12	V
T_{stg}	Storage Temperature Range	-65 to 150	°C
T_j	Junction Temperature Range	max 150	°C
	Load Dump (5ms rise, 115ms decay)	60	V

PIN CONNECTION



APPLICATION CIRCUIT



THERMAL DATA

Symbol	Parameter		Value	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	max	2	°C/W

ELECTRICAL CHARACTERISTICS (V_S = 10.5 to 16V; I_{O1} = 6mA, I_{O2} = 8mA, I_{O3} = 4mA; I_{O4} = 0.4mA; C_O = 10µF max; T_{amb} = -40 to 85°C, unless otherwise specified.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{O1}	Output Voltage	I_{O1} = 300mA; T_{amb} = 25°C; 11V < V_S < 16V all temps	9.7 9.5	10 10	10.3 10.5	V V
ΔV_{O1}	Load Regulation	I_{O1} = 6 to 300mA			150	mV
I_Q	Quiescent Current (ΔI_S)	V_S = 14V; I_{O1} = 6mA; V_S =14V ; I_{O1} = 300mA;			10 30	mA mA
V_S-V_{O1}	Dropout Voltage	I_{O1} = 300mA T_{amb} = 25°C; all temps			 400 600	 mV mV
I_L	Current Limit (Foldback) note1	V_{O1} = 0V	360		800	mA
V_{O1}	Max Bat.Trans.	R_O = 100Ω Ramp V_S from 14 to 60V in 3-5ms			11	V
		Hold V_S at 60V for 10ms Ramp V_S from 60 to 14V in 3-5ms; T_{amb} = 25°C; all temps	 9.7 9.5	 10 10	2 10.3 10.5	V V V
V_{O1}	Rev. Voltage Trans.	V_S = -35V; t ≤ 1ms; R_O = 100Ω Check V_{O1}, T_{amb} = 25°C; all temps	 9.7 9.5	 10 10	 10.3 10.5	 V V
V_{O1}	Rev. Voltage .	V_S = -15V; R_O = 100Ω	-0.4		1	V
	Ripple rejection	f_O = 1KHz; 1V_{pp} AC ; V_S=14V I_{O1} = 180mA; I_{O2} = 200mA; I_{O3} = 400mA; I_{O4} = 40mA;	50			dB
		f_O = 10KHz; 1V_{pp} AC ; V_S=14V I_{O1} = 180mA; I_{O2} = 200mA; I_{O3} = 400mA; I_{O4} = 40mA;	50			dB
ΔV_{O1}	Line Regulation ΔV_{O1} across V_S range	 V_S = 11V to 26V			 50	 mV
	Output Noise	Check Output for AC noise using a 100KHz LP filter Check Output for AC noise using an A weighted filter (20- 20KHz)			400 200	µV µV
V_{O2}	Output Voltage	I_{O2} = 400mA; T_{amb} = 25°C; all temps	7.75 7.60	8 8	8.25 8.40	V V
ΔV_{O2}	Load Regulation	I_{O2} = 8 to 400mA			150	mV
ΔI_Q	Quiescent Current (ΔI_S)	V_S = 14V; I_{O2} = 8mA; V_S = 14V; I_{O2} = 400mA;			10 35	mA mA
V_S-V_{O2}	Dropout Voltage	I_{O2} = 400mA set V_S = V_{O2}+1V; T_{amb} = 25°C; set V_S = V_{O2}+1.5V;all temps			 400 600	 mV mV
I_L	Current Limit (Foldback) note1	V_{O2} = 0V	480		960	mA
V_{O2}	Max Bat.Trans.	R_O = 100Ω Ramp V_S from 14 to 60V in 3-5ms			9	V
		Hold V_S at 60V for 10ms Ramp V_S from 60 to 14V in 3-5ms; T_{amb} = 25°C; all temps	 7.75 7.60	 8 8	2 8.25 8.40	V V V

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{O2}	Rev. Voltage Trans.	V_S = -35V; R_O = 100Ω t ≤ 1ms Check V_{O2}, standard T_{amb} = 25°C; all temps	 7.75 7.60	 8 8	 8.25 8.40	 V V
V_{O2}	Rev. Voltage .	V_S = -15V; t = 30s; R_O = 100Ω	-0.4		1	V
	Ripple rejection	f_O = 1KHz; 1V_{pp}AC ; V_S=14V I_{O1} = 180mA; I_{O2} = 200mA; I_{O3} = 400mA; I_{O4} = 40mA;	50			dB
		f_O = 10KHz; 1V_{pp}AC ; V_S=14V I_{O1} = 180mA; I_{O2} = 200mA; I_{O3} = 400mA; I_{O4} = 40mA;	50			dB
ΔV_{O2}	Line Regulation ΔV_{O2} across V_S range	 V_S = 10.5V to 26V			 40	 mV
V_{O3}	Output Voltage	I_{O3} = 600mA; T_{amb} = 25°C; all temps	4.85 4.75	5 5	5.15 5.25	V V
ΔV_{O3}	Line Regulation	V_S = 7V to 26V			40	mV
ΔV_{O3}	Load Regulation	I_{O3} = 4 to 600mA			100	mV
ΔI_Q	Quiescent Current (ΔI_S)	V_S = 14V; I_{O3} = 4mA; V_S = 14V; I_{O3} = 600mA;			8 40	mA mA
V_S-V_{O3}	Dropout Voltage	I_{O3} = 600mA set V_S = V_{O3}+1V; T_{amb} = 25°C; set V_S = V_{O3}+1.5V;all			 400 600	 mV mV
I_L	Current Limit (Foldback) note 1	V_{O3} = 0V	720		1440	mA
V_{O3}	Max Bat.Trans.	R_O = 100Ω Ramp V_S from 14 to 60V in 3-5ms			 6	 V
		Hold V_S at 60V for 10ms Ramp V_S from 60 to 14V in 3-5ms; T_{amb} = 25°C; all temps	 4.85 4.75	 5 5	2 5.15 5.25	V V V
V_{O3}	Rev. Voltage Trans.	V_S = -35V; t ≤ 1ms; R_O = 100Ω Check V_{O3}, standard T_{amb} = 25°C; all temps	 4.85 4.75	 5 5	 5.15 5.25	 V V
V_{O3}	Rev. Voltage .	V_S = -15V; R_O = 100Ω	-0.4		1	V
	Ripple rejection	f_O = 1KHz; 1V_{pp}AC ; V_S=14V I_{O1} = 180mA; I_{O2} = 200mA; I_{O3} = 400mA; I_{O4} = 40mA;	50			dB
		f_O = 10KHz; 1V_{pp}AC ; V_S=14V	50			dB
	Output Noise	Check Output for AC noise using a 100KHz LP filter Check Output for AC noise using an A weighted filter (20- 20KHz)			400 200	µV µV
V_{O4}	Output Voltage	I_{O4} = 100mA; T_{amb} = 25°C; all temps	4.85 4.75	5 5	5.15 5.25	V V
ΔV_{O4}	Line Regulation	V_S = 7V to 26V			40	mV
ΔV_{O4}	Load Regulation	I_{O4} = 0.4 to 100mA			80	mV
ΔI_Q	Quiescent Current	V_S = 14V; I_{O4} = 2mA; V_S = 14V; I_{O4} = 100mA;			450 20	µA mA
V_S-V_{O4}	Dropout Voltage	I_{O4} = 100mA set V_S = V_{O4}+0.5V; T_{amb} = 25°C; set V_S = V_{O4}+0.8V;all temps			 400 600	 mV mV
I_L	Current Limit (Foldback) note 1	V_{O4} = 0V	150		300	mA

ELECTRICAL CHARACTERISTICS (continued)

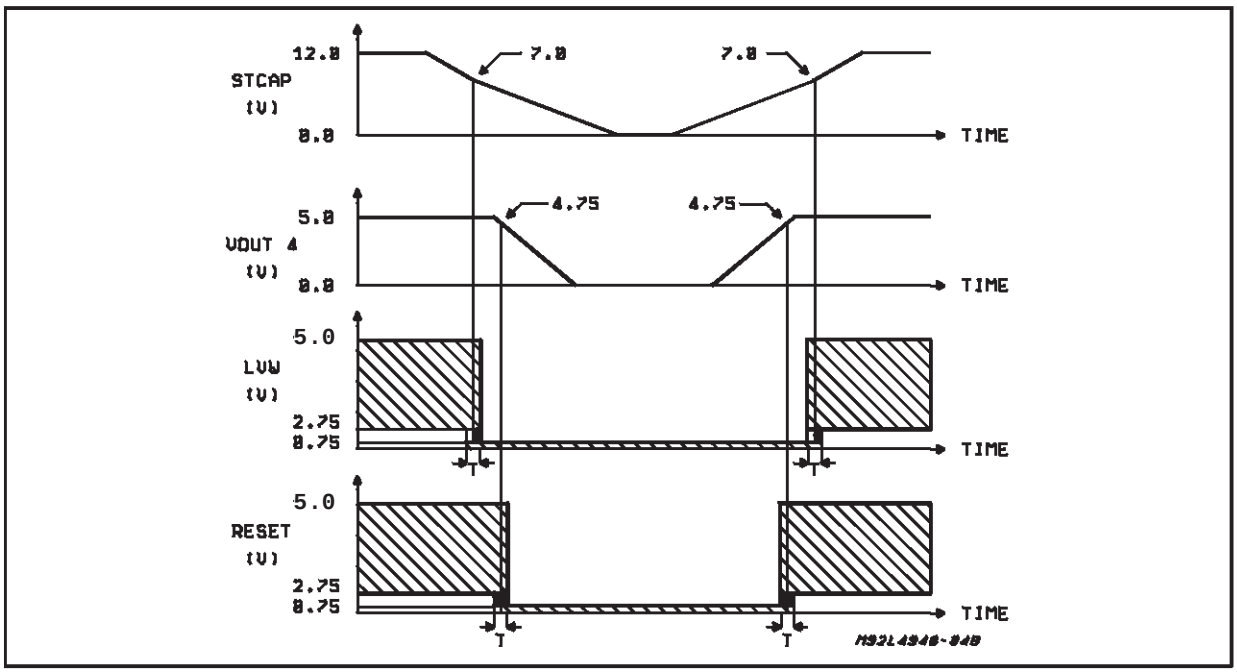
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{O4}	Max Bat.Trans.	R_O = 1000Ω Ramp V_S from 14 to 60V in 3-5ms			6	V
		Hold V_S at 60V for 10ms Ramp V_S from 60 to 14V in 3-5ms; T_{amb} = 25°C; all temps	 4.85 4.75	 5 5	6 5.15 5.25	V V V
V_{O4}	Rev. Voltage Trans.	V_S = -35V; t < 1ms; R_O = 1000Ω Check V_{O4}, standard T_{amb} = 25°C; all temps	 4.85 4.75	 5 5	 5.15 5.25	 V V
V_{O4}	Rev. Voltage .	V_S = -15V; R_O = 1000Ω	-0.4		1	V
	Ripple rejection	f_O = 1KHz; 1V_{pp} AC ; V_S=14V I_{O1} = 180mA; I_{O2} = 200mA; I_{O3} = 400mA; I_{O4} = 40mA;	50			dB
		f_O = 10KHz; 1V_{pp} AC ; V_S=14V I_{O1} = 180mA; I_{O2} = 200mA; I_{O3} = 400mA; I_{O4} = 40mA;	50			dB
	Output Noise	Check Output for AC noise using a 100KHz LP filter Check Output for AC noise using an A weighted filter (20-20KHz)			400 200	µV µV
ON/OFF	Input Current	V_S = 14V; V_{IH} = >2V; V_S = 14V; V_{IL} = <0.8V;	 -10		1	µA µA
$V_{I\ ON/OFF}$	Input Threshold	V_S = 14V V_{IL} V_S = 14V V_{IH}	0 2		0.8 12	V V
V_R	Reset Output Voltage Set	V_S so that V_{O4} < 4.5V; R_O = 200KΩ to V_{04}; V_{IL} = ”0”	0		0.75	V
		V_S so that V_{O4} -0.15V; R_O = 200KΩ to V_{04}; V_{IH} = ”1”	2.75		5	V
	LVW and Reset fall Time Set	Measured from 90% to 10%			150	µs
	LVW and Reset Rise Time	Measured from 90% to 100%			300	µs
	LVW Output Threshold	Ramp V_S down until LVW switches from”1” to a ”0”	7.0		8.2	V
	LVW Output Voltage	STCAP <6.5V;R_O = 200KΩ to V_{O4}; V_{IL} = ”0”	0		0.75	V
		STCAP >7.5V;R_O = 200KΩ to V_{O4}; V_{IH} = ”1”	2.75		50	V
	Reset Output Stability	V_S is set such that 1 ≤ V_{04} ≤ 4V; I_{OUT4} = 2mA; $V_{ON/OFF}$ = 0 meas reset variation			50	mV
I_q	St-By Quiescent Current (ΔI_S)	$V_{ON/OFF}$ = 0V; $I_{O\ 4}$ = 100mA; V_S = 14V; $I_{O\ 1,2,3}$ = 0mA			20	mA
		$V_{ON/OFF}$ = 0V; $I_{O\ 4}$ = 2mA; V_{bat} = 14V; $I_{O\ 1,2,3}$ = 0mA			500	µA
	Maximum Quiescent Current (ΔI_S)	V_S = 14V; I_{O1} = 300mA; I_{O2} = 400mA; I_{O3} = 600mA; I_{O4} = 100mA; V_O = 5V			110	mA
	STCAP Output Voltage	V_S = 24V;	15		17	V
		V_S = 60V. 1ms			18	V

Note 1:
The L4948 has ”Foldback” on its outputs during current limiting. As the output loading is increasing the current supplied by the L4948 increases until a threshold is reached. When the current limiting threshold is reached, the L4948 output current will start to accrease as the loading is continuoing to increase. The point where the output current stort to decrease is the maximum output current.

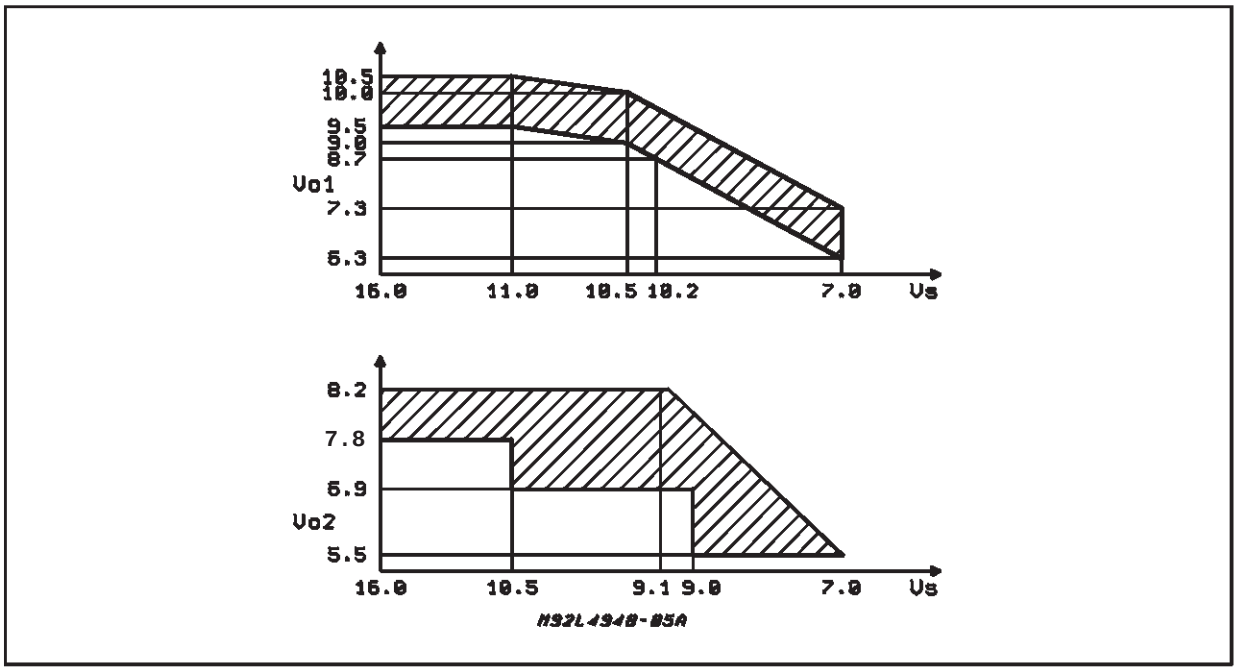
FUNCTIONAL DESCRIPTION

The L4948 includes a monitoring circuit to warn the microprocessor if a low voltage or no voltage condition is occurring. Between 6.5V and 7.5V on the STCAP pin, the LVW output will go low. This tells the microprocessor to stop executing code and save vital information. The reset output will go low when V_{04} drops 0.15V below it's typical reading. A reset will occur between a minimum of 4.5 and a maximum of 5V on V_{04}. When the V_{04} drops between 4.5 and 5V the RESET output goes low. It is very important that the RESET output doesn't go above 0.75V until the V_{04} output has gone back above 4.75V (typical). The microprocessor looks for a rising edge. So, any spike will tell the microprocessor to start operating. Once the STCAP line passes 7V (typical), the LVW output will also return to high state.

TIMING DIAGRAM



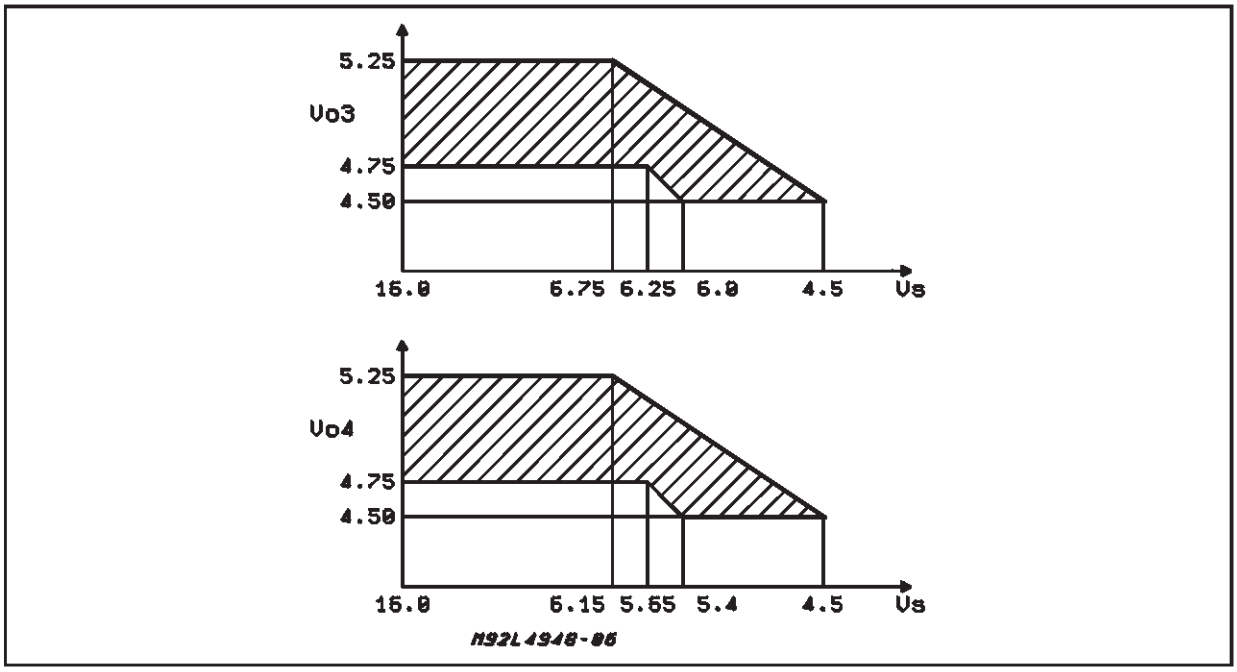
Graphs of the Output Curves for $V_{O1,2,3 \text{ and } 4}$



The STCAP pin acts like a delay circuit. Due to the large capacitor (470µF), the STCAP pin allows the battery voltage to decay slowly giving the microprocessor time to store data. Also, during short low voltage or negative voltage conditions, the STCAP pin protects the 5V st-by output from dropping below the RESET and LVW trip points The four outputs are expected to follow the battery voltage down to 7V. At 7V typical the LVW tells the microprocessor to stop operation and save operating data Below 7V the outputs are expected to stay alive and ready for a return of battery.

The L4948 has a st-by mode to keep the microprocessor and memories allive during an ignition off conditions. The ON/OFF input pin in controlled by the microprocessor. An high on the ON/OFF pin places the part in normal mode. A low on the ON/OFF pin places the part in st-by mode.V_{01}, V_{02}, V_{03} will be off during st-by mode.

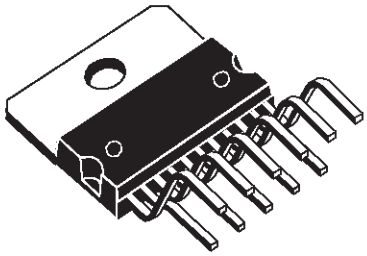
Graphs of the Output Curves for $V_{O1,2,3}$ and 4 (Cont.)



Notes and Information
The following information is for clarification, not for specification definition.
Please use the information in this way.

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			5			0.197
B			2.65			0.104
C			1.6			0.063
D		1			0.039	
E	0.49		0.55	0.019		0.022
F	0.88		0.95	0.035		0.037
G	1.45	1.7	1.95	0.057	0.067	0.077
G1	16.75	17	17.25	0.659	0.669	0.679
H1	19.6			0.772		
H2			20.2			0.795
L	21.9	22.2	22.5	0.862	0.874	0.886
L1	21.7	22.1	22.5	0.854	0.87	0.886
L2	17.4		18.1	0.685		0.713
L3	17.25	17.5	17.75	0.679	0.689	0.699
L4	10.3	10.7	10.9	0.406	0.421	0.429
L7	2.65		2.9	0.104		0.114
M	4.25	4.55	4.85	0.167	0.179	0.191
M1	4.73	5.08	5.43	0.186	0.200	0.214
S	1.9		2.6	0.075		0.102
S1	1.9		2.6	0.075		0.102
Dia1	3.65		3.85	0.144		0.152

OUTLINE AND MECHANICAL DATA



Multiwatt11 V