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MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Document order number: MC34710
Rev 1.0, 04/2004

Preliminary Information

Adjustable Dual Output Switching Power Supply

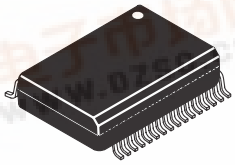
34710

ADJUSTABLE DUAL OUTPUT SWITCHING POWER SUPPLY

The 34710 is a dual-output power regulator IC that integrates a switching regulator, a linear regulator, supervisor circuitry, and a power supply sequencer. With a wide operating input voltage range of 12 V to 32 V and robust temperature limits, the 34710 is applicable in many commercial and industrial applications that use an MCU.

A user-selectable 5.0 V/3.3 V buck switching regulator is provided for board-level I/Os and user circuitry. The regulator is capable of delivering up to 1.0 A. The MCU core voltage is an adjustable 3.3 V/2.5 V/1.8 V/1.5 V linear voltage regulator that can supply up to 500 mA.

The switching and linear regulator output voltage are determined through three digital input mode terminals that can be controlled by an MCU.



EW (Pb-FREE) SUFFIX
CASE 1324-02
32-LEAD SOICW-EP

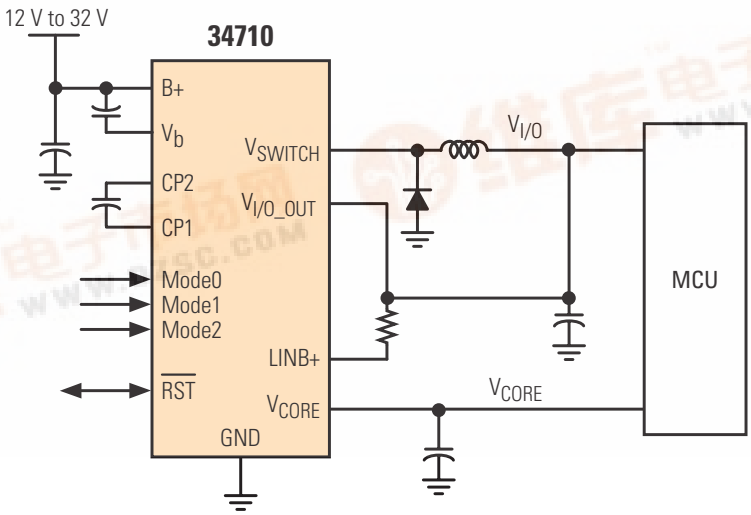
Features

- High-Current Adjustable 5.0 V/3.3 V Switching Regulator
- Low Noise User-Selectable 3.3 V/2.5 V/1.8 V/1.5 V Linear Regulator
- On-Chip Thermal Shutdown and Error Reset Circuitry
- Supervisory Functions (Power-ON Reset and Error Reset Circuitry)
- Sequenced I/O and Core Voltages
- Pb-Free Packaging Designated by Suffix Code EW

ORDERING INFORMATION

Device	Temperature Range (T_A)	Package
PC34710EW/R2	0°C to 85°C	32 SOICW-EP

34710 Simplified Application Diagram



PRELIMINARY
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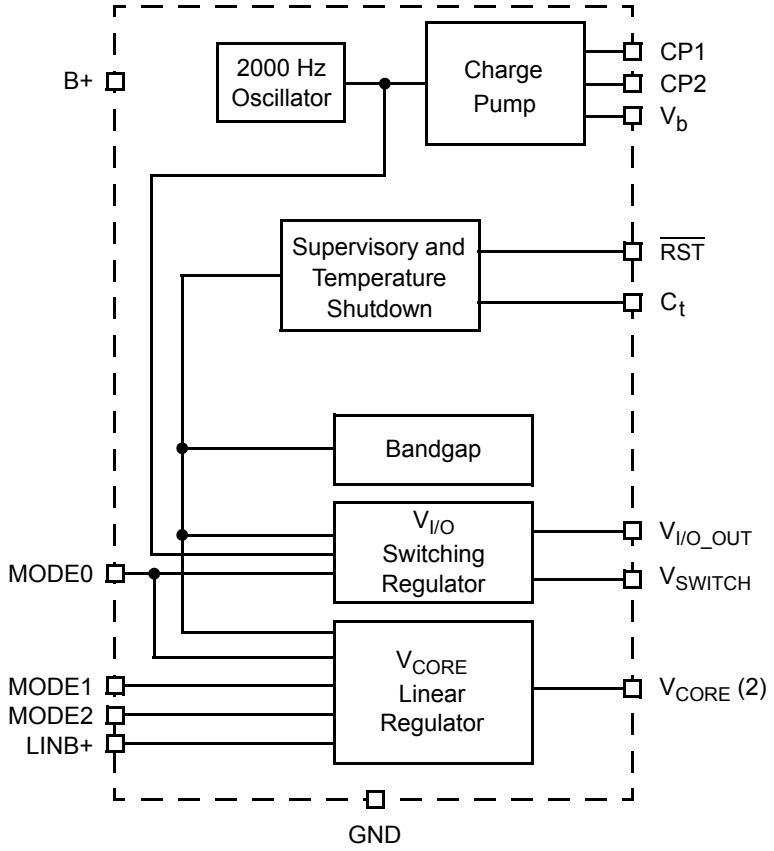

Figure 1. 34710 Simplified Internal Block Diagram

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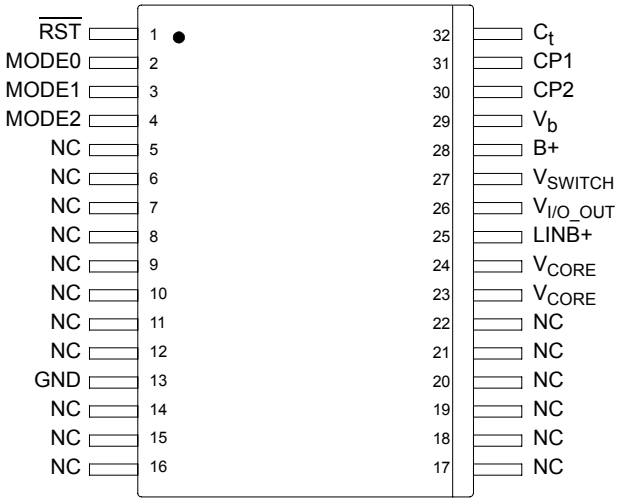

TERMINAL FUNCTION DESCRIPTION

Terminal	Terminal Name	Formal Name	Definition
1	$\overline{RST}$	Reset	Reset input and output. This terminal is open drain.
2 3 4	MODE0 MODE1 MODE2	Mode Control	These input terminals control V_{I/O_OUT} and V_{CORE} output voltages.
5–12, 14–22	NC	No Connects	No internal connection to this terminal.
13	GND	Ground	Ground.
23, 24	V_{CORE}	Core Voltage Regulator Output	Core regulator output voltage.
25	LINB+	Core Voltage Regulator Input	Core regulator input voltage.
26	V_{I/O_OUT}	$V_{I/O}$ Switching Regulator Feedback	Feedback terminal for $V_{I/O}$ switching regulator and internal logic supply.
27	V_{SWITCH}	$V_{I/O}$ Switching Regulator Switch Output	$V_{I/O}$ switching regulator switching output.
28	B+	Power Supply Input	Regulator input voltage.
29	V_b	Boost Voltage	Boost voltage storage node.
30	CP2	Switching Capacitor 2	Charge pump capacitor connection 2.
31	CP1	Switching Capacitor 1	Charge pump capacitor connection 1.
32	C_t	Reset Delay Capacitor	Reset delay adjustment capacitor.

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MAXIMUM RATINGS

All voltages are with respect to ground unless otherwise noted.

Rating	Symbol	Max	Unit
GLOBAL ABSOLUTE MAXIMUM RATINGS			
Input Power Supply Voltage I_{B+} = 0 A	V_{B+}	-0.3 to 36	V
Terminal Soldering Temperature (Note 1)	T_{SOLDER}	260	°C
Power Dissipation (Note 2)	P_D	3.0	W
ESD Standoff Voltage Non-Operating, Unbiased, Human Body Model (Note 3)	V_{ESD1}	±2000	V
Thermal Resistance Junction-to-Ambient (Note 4) Junction-to-Ambient (Note 2) Junction-to-Case	 $R_{\theta JA}$ $R_{\theta JA}$ $R_{\theta JC}$	 45 25 2.0	°C/W
GLOBAL OPERATING RATINGS			
Operating Ambient Temperature	T_A	0 to 85	°C
Operating Device Junction Temperature	T_J	105	°C
Input Power Supply Voltage I_{B+} = 0 A to 3.0 A	V_{B+}	12 to 32	V
Quiescent Bias Current from B+ (Note 5) V_{B+} = 12 V to 32 V	$I_{B+}(q)$	7.5	mA
Operating Junction Temperature	T_J	-0 to 105	°C
$V_{I/O}$ SWITCHING REGULATOR (Note 6)			
Maximum Output Voltage Startup Overshoot (C_{OUT} = 330 μF) MODE0 = 0 MODE0 = Open	$V_{I/O}$(STARTUP)	 5.4 3.6	V
Maximum Output Current T_A = 0°C to 105°C	$I_{VI/O}$	1.2	A

Notes

1. Soldering temperature limit is for 10 seconds maximum duration. Not designed for immersion soldering. Exceeding these limits may cause malfunction or permanent damage to the device.
2. With 2.0 in^2 of copper headsink.
3. ESD1 testing is performed in accordance with the Human Body Model (C_{ZAP} = 100 pF, R_{ZAP} = 1500 Ω).
4. With no additional heatsinking.
5. Maximum quiescent power dissipation is 0.25 W.
6. 12 V ≤ V_{B+} ≤ 32 V and -20°C ≤ T_J ≤ 145°C unless otherwise noted.

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MAXIMUM RATINGS (continued)

All voltages are with respect to ground unless otherwise noted.

Rating	Symbol	Max	Unit
V_{CORE} LINEAR REGULATOR (Note 7)			
Maximum Output Voltage Startup Overshoot (C_{OUT} = 10 µF) (Note 8)	V_{CORE}(STARTUP)		V
MODE[2:0] = [0,x,0]		3.6	
MODE[2:0] = [0,x,Open]		2.7	
MODE[2:0] = [Open,x,0]		2.0	
MODE[2:0] = [Open,x,Open]		1.65	
Maximum Output Current	I_{VCORE}		mA
T_J = 0°C to 105°C, $V_{LINB+} \leq V_{CORE}$(NOM) + 0.8 V (Note 9)		500	

Notes

7. 12 V ≤ V_{B+} ≤ 32 V and -20°C ≤ T_J ≤ 145°C unless otherwise noted.
8. Refer to Table 1, page 10.
9. Pulse testing with low duty cycle used.

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STATIC ELECTRICAL CHARACTERISTICS

Characteristics noted under conditions 4.75 V ≤ V_{IO} ≤ 5.25 V, 12 V ≤ V_{B+} ≤ 32 V, and 0°C ≤ T_J ≤ 105°C unless otherwise noted. Typical values noted reflect the approximate parameter mean at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
$V_{I/O}$ SWITCHING REGULATOR					
Logic Supply Voltage ($I_{VI/O}$ = 25 mA to 1.0 A) MODE0 = 0 MODE0 = Open	$V_{I/O}$	 4.8 3.15	 – –	 5.2 3.45	V
Logic Supply Current $V_{I/O}$ = Nominal, Power Dissipation in Switching Regulator = 0.45 W	$I_{VI/O}$	0.025	–	1.0	A
Output On Resistance V_{B+} = 12 V to 32 V	$R_{DS(ON)}$	0.5	TBD	2.0	Ω
Soft Start Threshold Voltage MODE0 = X	$V_{I/O}$(SOFT)	–	–	2.5	V
Current Limit Threshold (T_J = 25°C to 100°C) Normal Operation Soft Start, $V_{I/O}$ ≤ 2.5 V	 I_{LIMIT}(OP) I_{LIMIT}(SOFT)	 2.1 1.3	 – –	 3.2 1.8	A
Minimum Voltage Allowable on V_{SWITCH} Terminal T_J = 25°C to 100°C	$V_{VSWITCH}$(MIN)	-0.5	–	–	V
V_{CORE} LINEAR REGULATOR					
Supply Voltage (I_{VCORE} = 5.0 mA to 500 mA) (Note 10) MODE[2:0] = [0,x,0] MODE[2:0] = [0,x,Open] MODE[2:0] = [Open,x,0] MODE[2:0] = [Open,x,Open]	V_{CORE}(NOM)	 3.15 2.35 1.71 1.425	 – – – –	 3.45 2.65 1.89 1.575	V
Supply Current V_{CORE} = V_{CORE}(NOM)	I_{VCORE}	1.0	–	500	mA
V_{CORE} Dropout Voltage V_{CORE} = V_{CORE}(NOM), I_{VCORE} = 0.5 A	I_{VCORE}(DROPOUT)	0.8	–	–	V
Regulator Input Voltage V_{CORE} = V_{CORE}(NOM), I_{VCORE} = 0.5 A	V_{LINB+}	V_{CORE}(NOM) + 1.0	–	10	V
Normal Current Limit Threshold T_J = 25°C to 100°C, V_{LINB+} = V_{CORE}(NOM) + 1.0 V	I_{LIMIT}	800	–	1000	mA

Notes

10. Refer to Table 1, page 10.

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STATIC ELECTRICAL CHARACTERISTICS (continued)

Characteristics noted under conditions 4.75 V ≤ V_{IO} ≤ 5.25 V, 12 V ≤ V_{B+} ≤ 32 V, and 0°C ≤ T_J ≤ 105°C unless otherwise noted. Typical values noted reflect the approximate parameter mean at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
MODE TERMINALS OPERATING VOLTAGES					
MODE Control Terminals Low Voltage T_J = 0°C to TBD°C, V_{B+} = 12 V to 32 V	V_{IL}(MODEn)	–	–	0.825	V
MODE Control Terminals High Voltage T_J = 0°C to TBD°C, V_{B+} = 12 V to 32 V	V_{IH}(MODEn)	2.6	–	–	V
MODE Control Terminals Voltage with Input Floating T_J = 0°C to TBD°C, V_{B+} = 12 V to 14 V T_J = 0°C to TBD°C, V_{B+} = 14 V to 32 V	V_{MODE}(FLOAT)	7.0 8.0	– –	12 13.2	V
SUPERVISOR CIRCUITRY					
Minimum Function V_{B+} for Charge Pump and Oscillator Running	V_{B+}(MIN)	9.0	–	–	V
Minimum V_{B+} for $\overline{RST}$ Assertion, V_{B+} Rising	V_{B+}(ASSERT)	2.0	–	–	V
$\overline{RST}$ Low Voltage V_{B+} = 2.0 V, $I_{\overline{RST}}$ ≤ 5.0 mA	V_{OL}	–	–	0.4	V
$\overline{RST}$ $V_{I/O}$ Threshold $V_{I/O}$ Rising $V_{I/O}$ Falling	 $V_{I/O}t+$ $V_{I/O}t-$	 – $V_{I/O}$(NOM) - 225 mV	 – –	 $V_{I/O}$(NOM) - 80 mV –	V
$\overline{RST}$ Hysteresis for $V_{I/O}$	$V_{HYSVI/O}$	10	–	100	mV
$\overline{RST}$ V_{CORE} Threshold V_{CORE} Rising V_{CORE} Falling	 $V_{CORE}t+$ $V_{CORE}t-$	 – V_{CORE}(NOM) - 225 mV	 – –	 V_{CORE}(NOM) - 80 mV –	V
$\overline{RST}$ Hysteresis for $V_{\overline{CORE}}$ V_{B+} = 12 V to 32 V	$V_{HYS\ CORE}$	10	–	100	mV
V_{CORE} - $V_{I/O}$ for V_{CORE} Shutdown V_{B+} = 12 V to 32 V	V_{CORE}(SHUTDOWN)	–	–	TBD	V
Thermal Shutdown Temperature T_J Rising	T_J(TSD)	170	–	–	°C
Overtemperature Hysteresis	T_J(HYSTERESIS)	20	–	TBD	°C
V_b CHARGE PUMP					
Boost Voltage (Note 11) V_{B+} = 12 V to 32 V, I_{vb} = 0.5 mA	V_b	V_{B+}+10 V	–	V_{B+}+12 V	V

Notes

11. Bulk capacitor ESR ≤ 10 Ω.

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DYNAMIC ELECTRICAL CHARACTERISTICS

Characteristics noted under conditions 4.75 V ≤ V_{IO} ≤ 5.25 V, 12 V ≤ V_{B+} ≤ 32 V, and 0°C ≤ T_J ≤ 105°C unless otherwise noted. Typical values noted reflect the approximate parameter mean at T_A = 25°C under nominal conditions unless otherwise noted

Characteristic	Symbol	Min	Typ	Max	Unit
$V_{I/O}$ SWITCHING REGULATOR					
Duty Cycle	D	45	–	55	%
Switching Rise and Fall Time Load Resistance = 100 Ω, V_{B+} = 30 V	t_r, t_f	25	–	–	ns
Switching Rise and Fall Time Load Resistance = 100 Ω, V_{B+} = 30 V	$t_r + t_f$	–	–	50	ns
SUPERVISOR CIRCUITRY					
$\overline{RST}$ Delay C_{delay} = 0.1 μF	t_{delay}	48	–	82	ms
$\overline{RST}$ Filter Time V_{B+} = 9.0 V	t_{filter}	1.0	–	6.0	μs
$\overline{RST}$ Fall Time C_L = 100 pF, R_{PULLUP} = 4.7 kΩ, 90% to 10%	t_f	–	–	125	ns
External Low (Note 12) $V_{I/O}$ = 5.0 V	t_{slpl} (Note 13)	30	–	–	ns
$\overline{RST}$ Recovery Time Before Next $\overline{RST}$ Input (Note 12) $V_{I/O}$ = 5.0 V	t_{phsl}	–	–	10	μs
INTERNAL OSCILLATOR					
Charge Pump and $V_{I/O}$ Switching Regulator Operating Frequency V_{B+} = 9.0 V to 32 V	f_{OP}	140	–	260	kHz

Notes

12. See Figure 2, RST Timing, page 9.
13. t_{slpl} is an input.

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Timing Diagram

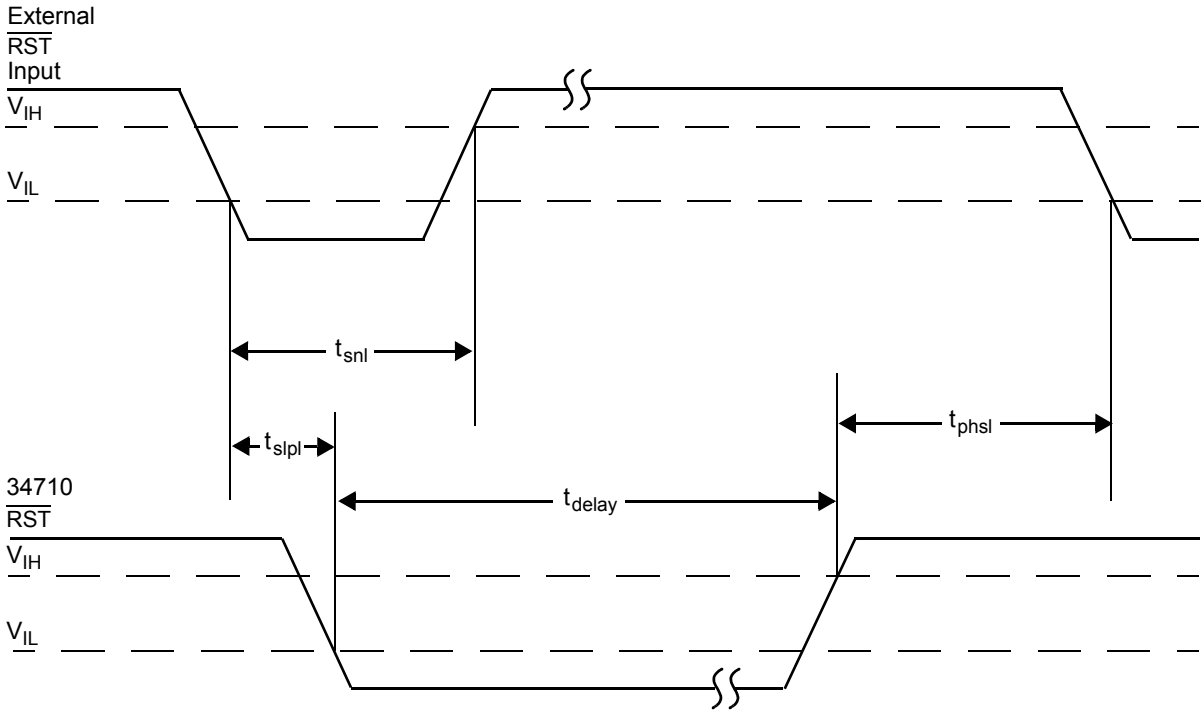

Figure 2. $\overline{\text{RST}}$ Timing

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SYSTEM/APPLICATION INFORMATION

INTRODUCTION

$V_{I/O}$ Switching Regulator

The $V_{I/O}$ switching regulator output voltage is determined by the MODE digital input terminals. The 34710's MODE[2:0] select the output voltage (Table 1). For example, if MODE[2:0] = 0, 0, 0, then $V_{I/O}$ = 5.0 V; if MODE[2:0] = Open, Open, Open, then $V_{I/O}$ = 3.3 V. The MODE0 terminal controls the output voltage of both regulators.

The topology of the regulator is a bang-bang buck regulator operating from the internal ~200 kHz oscillator.

V_{CORE} Linear Regulator

The V_{CORE} linear regulator can produce a +3.3 V, 2.5 V, 1.8 V, or 1.5 V output voltage at 500 mA. The input to the V_{CORE} regulator is a terminal that may be connected to the $V_{I/O}$ regulator output. The minimum input voltage must be V_{CORE}(NOM) + 0.8 V.

The MODE[2:0] terminals select the output voltage as depicted in Table 1.

Table 1. $V_{I/O}$ and V_{CORE}(NOM) Regulator Output Voltage Selection

MODE2	MODE1	MODE0	$V_{I/O}$ (V)	V_{CORE}(NOM) (V)
0	0	0	5.0	3.3
0	0	Open	3.3	2.5
0	Open	0	5.0	1.8
0	Open	Open	3.3	1.8
Open	0	0	5.0	2.5
Open	0	Open	3.3	2.5
Open	Open	0	5.0	1.5
Open	Open	Open	3.3	1.5

Open indicates terminal is not connected externally.

SUPERVISORY AND MISCELLANEOUS FUNCTIONS

Introduction

The supervisor circuitry provides control of the $\overline{RST}$ line, an open drain signal, based on system operating conditions monitored by the 34710. $V_{I/O}$, V_{CORE}, V_{B+}, and thermal shutdown (TSD) detectors in various parts of the chip are monitored for error conditions. Because other devices in the system may trigger a reset, the $\overline{RST}$ line itself is also monitored, but the supervisor circuitry controls all reset timing, including externally generated resets. Driving the $\overline{RST}$ line low causes the system to be held in the reset state. $V_{I/O}$, V_{CORE}, V_{B+}, and thermal shutdown have both positive- and negative-going thresholds.

The supervisor circuitry also ensures that the power supplies sequence properly. Specifically, that $V_{I/O}$ is never less than TBD V below V_{CORE}. This means that V_{CORE} - $V_{I/O}$ will be clamped at 0.5 V, and that the V_{CORE} regulator operation will be suppressed during startup and shutdown to ensure that V_{CORE} - $V_{I/O}$ = TBD V.

Static Operating Specifications

The $\overline{RST}$ output is an I/O device with an open drain output driver with a pullup and a CMOS digital input gate (Figure 3). This I/O structure allows wired OR connection to the MCU's $\overline{RST}$ I/O terminal, as well as allowing the MCU to initiate a reset cycle by driving its $\overline{RST}$ terminal low. When responding to a MCU request for a reset cycle, the 34710 must respond rapidly enough to prevent a glitch. Figure 2, page 9, shows the timing parameters for responding to an externally applied $\overline{RST}$ signal. The rise time may be relatively slow, depending on the load capacitance, and the internal $\overline{RST}$ input gate must operate reliably (no oscillations during the transition) under these conditions, i.e., the $\overline{RST}$ input can be inhibited for up to t_{phsl}(MAX). Error conditions must be present for a minimum time, t_{filter}, before the 34710 responds to them. Once all error conditions are cleared, $\overline{RST}$ is held low for an additional time of t_{delay}. If any monitored item falls below its negative-going threshold for t_{filter}, 1.0 µs to 6.0 µs, the t_{delay} will be restarted when system operating conditions are met. The trigger for the t_{delay} retriggerable one shot should be ([$V_{I/O}$(LOW) + V_{CORE}(LOW) + V_{B+}(LOW) + T_J(TSD)] & t_{filter}), where t_{filter} is the 1.0 µs to 6.0 µs delay.

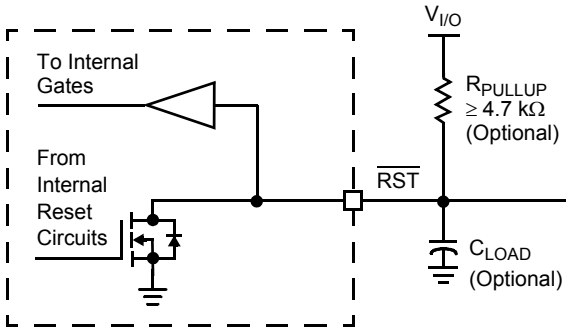

Figure 3. $\overline{RST}$ Terminal Interface

V_b Charge Pump

The high-side MOSFETs in the H-Bridge motor drivers and voltage regulators switch require a gate voltage in excess of V_{B+}, which is provided by the V_b supply. The V_b regulator is a charge pump, switching directly off the V_{B+} supply, and uses an internal oscillator operating at 200 kHz.

Internal Oscillator

The internal oscillator provides timing for the charge pump and switching regulators.

APPLICATIONS

Power Dissipation

The power budget is described in Table 2. The maximum dissipation for this device is 1.0 W continuous.

Table 2. Power Budget

Functional Block	Watt
Bias	0.00
Charge Pump	0.15
Switching Regulator	0.45
Linear Regulator	0.35
Total	**0.95**

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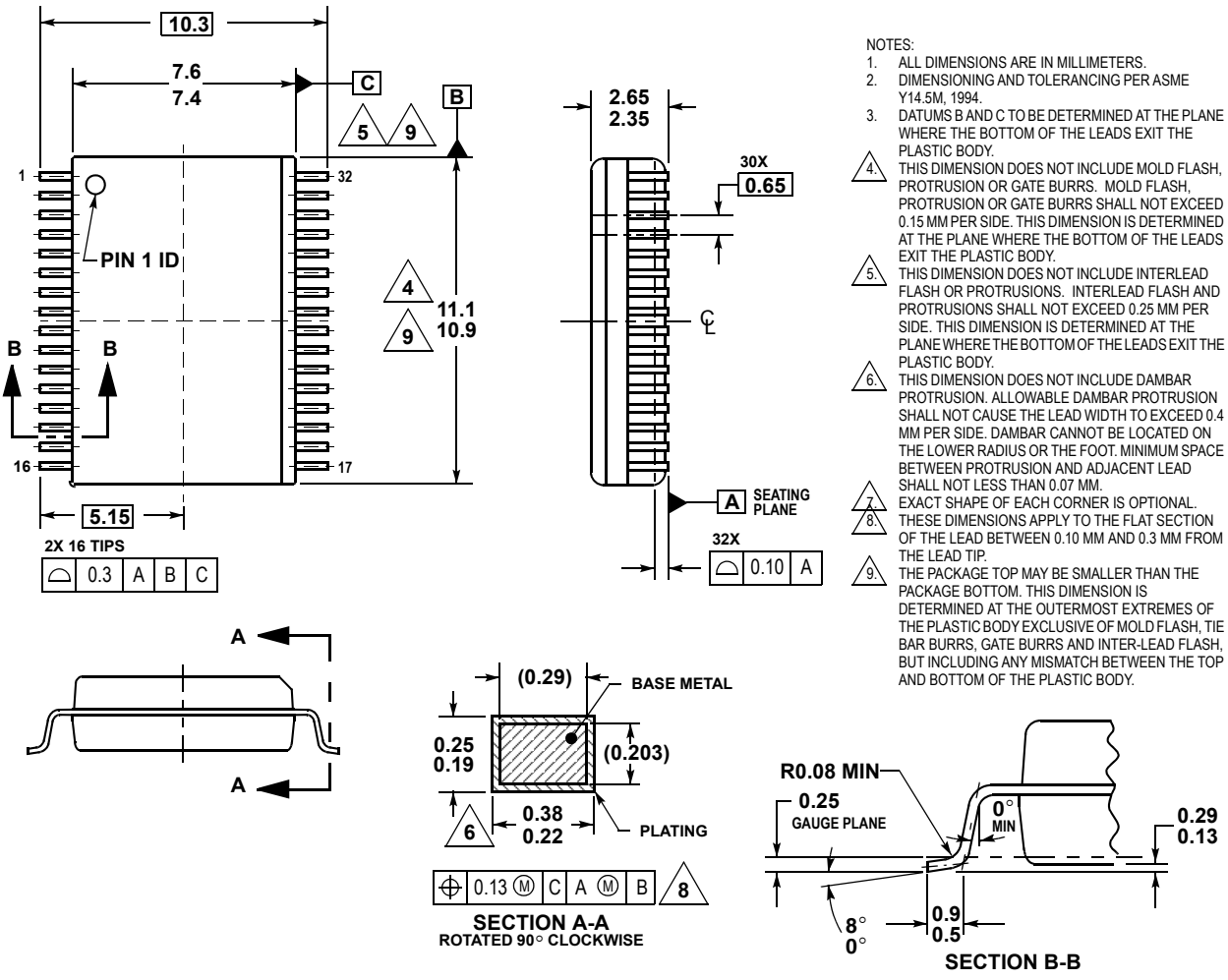
PACKAGE DIMENSIONS

EW (Pb-FREE) SUFFIX
32-LEAD SOICW-EXPOSED PAD
PLASTIC PACKAGE
CASE 1324-02
ISSUE A



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
3. DATUMS B AND C TO BE DETERMINED AT THE PLANE WHERE THE BOTTOM OF THE LEADS EXIT THE PLASTIC BODY.
4. THIS DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS. MOLD FLASH, PROTRUSION OR GATE BURRS SHALL NOT EXCEED 0.15 MM PER SIDE. THIS DIMENSION IS DETERMINED AT THE PLANE WHERE THE BOTTOM OF THE LEADS EXIT THE PLASTIC BODY.
5. THIS DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS. INTERLEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED 0.25 MM PER SIDE. THIS DIMENSION IS DETERMINED AT THE PLANE WHERE THE BOTTOM OF THE LEADS EXIT THE PLASTIC BODY.
6. THIS DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED 0.4 MM PER SIDE. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND ADJACENT LEAD SHALL NOT LESS THAN 0.07 MM.
7. EXACT SHAPE OF EACH CORNER IS OPTIONAL.
8. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10 MM AND 0.3 MM FROM THE LEAD TIP.
9. THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM. THIS DIMENSION IS DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTER-LEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.

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