Great Mixed Signal Technologies

GMT38LV5x

5 VOLT CURRENT-MODE PWM CONTROLLERS

With GMT Exclusive ISSP* Protective Circuitry

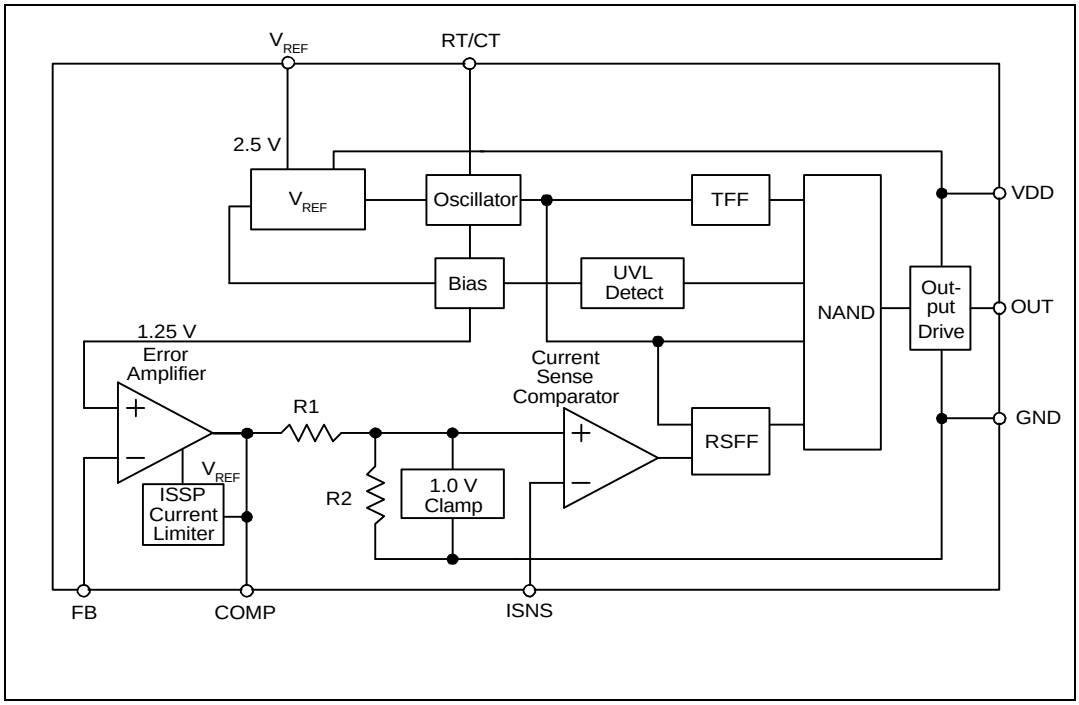
DESCRIPTION

The new GMT38LV5x devices are high-performance BiCMOS current-mode Pulse Width Modulators based on the industry-standard UC384x architecture, but optimized for 5 Volt operation. The GMT38LV5x family of controllers also offers many other improvements over the standard products. In addition to lower start-up voltage and currents, these devices exhibit improved voltage reference characteristics and fast current sense response to enhance overall system performance. The CMOS output driver provides rail-to-rail swings for the external power MOSFET, and exhibits low cross-conduction for more efficient high-frequency operation. Minimum duty cycle range at 500 KHz is specified for designer convenience. Devices are available for both 0% to 49% and 0% to 98% nominal duty cycle operation. The GMT38LV5x devices are offered in MSOP, SOIC, and DIP packages.

FEATURES

- Operational from +3.0 Volts to +5.5 Volts.
- Low start-up voltage: +4.0 Volts typical.
- Low start-up current: 50 µA.
- Low supply current: 5.0 mA max.
- Tight initial reference voltage: ±2%.
- Current sense delay time: 50 nS typical.
- High frequency operation up to 500 KHz.
- Low driver shoot-through current, typically 4.0 mA at 500 KHz.
- C drive performance in MSOP package.
- HC drive performance in SOIC and DIP packages.
- ESD protected to 2000 Volts.

ISSP is the GMT patent-pending **Indefinite **S**econdary **S**hort Circuit **P**rotection circuitry, which allows the PWM to run INDEFINITELY into a short-circuited load, with NO external components and NO significant temperature rise in either the PWM or the power switching elements.*



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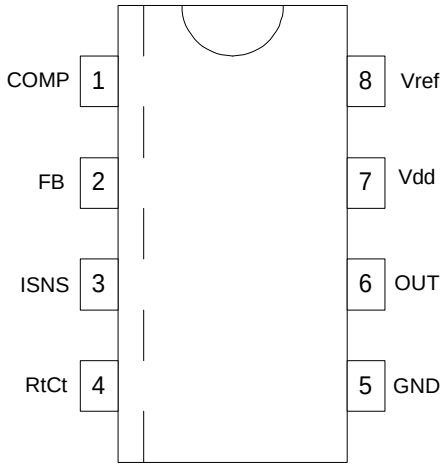
PACKAGE DIAGRAM



8 Pin DIP
8 Pin SOIC
8 Pin MSOP

Table 1: Pin Descriptions

Pin Function	Pin No.	Pin Description
COMP	1	Compensation pin/Error Amplifier output; allows connection of external compensation network. The COMP Pin also can be used as an Error Amplifier shutdown by pulling to ground.
FB	2	Feedback input from desired power supply output.
I_{SNS}	3	Current sense comparator input.
RtCt	4	Oscillator RC network node.
GND	5	Analog and Digital GND connection.
OUT	6	PWM totem-pole output drive.
Vdd	7	Power supply connection.
Vref	8	Reference voltage output; must have a filter capacitor to ground present of between 0.01 and 1.0 uF MAX.

TABLE 2: DEVICE SELECTION GUIDE

DUTY CYCLE	8-Pin Plastic Dip	8-Pin SOIC	8-Pin MSOP
0% to 49%	38LV55INM08	38LV55IN08	38LV55IR08
0% to 98%	38LV53INM08	38LV53IN08	38LV53IR08

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage VDD ..... 7.0 V
$V_{Feedback}$ ..... -0.3 V to +2.8 V
V_{Isense} ..... -0.3 V to +2.8 V
ESD Rating[2] ..... 2000 V
Package Thermal Resistance θ_{JA}
- 8-Pin Plastic DIP ..... 125°C/W
- 8-Pin MSOP ..... 250°C/W
- 8-Pin SOIC ..... 170°C/W

Operating Junction Temperature Range .... -40°C to +150°C
Storage Temperature Range ..... -60°C to +150°C
Lead Temperature (soldering, 10 sec) ..... +300°C

Note1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.
Note 2: MIL std. 883 D Human Body Model, Method 3015.7 at +25°C

RECOMMENDED OPERATING CONDITIONS[3]

Supply Voltage VDD ..... 3.0 V to 5.5 V
$V_{Feedback}$ ..... +1.0 V to +1.5 V
V_{Isense} ..... 0.0 V to +1.5 V
Reference Voltage Load Current ..... 1.0 mA to 10 mA
Operating AMbient Temperature Range ..... -40°C to +85°C
Power Dissipation:
- 8-Pin Plastic Dip: 400 mW. Derate at 8 mW/°C for T_A>35°C
- 8-Pin SOIC: 300 mW. Derate at 6 mW/°C for T_A>35°C
- 8-Pin MSOP: 200 mW. Derate at 4 mW/°C for T_A>35°C

Note 3: Recommended Operating Conditions are limits over which the device is functional, and electrical specifications are guaranteed. This includes an upper operating junction temperature of +125°C. At elevated ambient temperatures, device power dissipation must be derated based on package thermal resistance.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{DD} = +5.0 V, R_T = 10 K, C_T =3.3 nF, C_{Byp}= 1.0 µF min with ESR ≤ 5 Ω, and T_A = -40°C to +85°C

Table 3: REFERENCE SECTION

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	I_{LOAD} = 1.0 mA, T_J = 25°C	2.450	2.500	2.550	V
Line Regulation	I_{LOAD} = 1.0 mA, T_J = Constant 4.5 V≤V_{DD} ≤5.5 V 3.0 V≤V_{DD} ≤4.5 V		 1.0 5.0	 4.0 20	 MV mV
Load Regulation	I_{LOAD} = 1.0 mA to 10 mA T_J = Constant		1.0	15	mV
Temperature Stability[4]	-40°C ≤ T_J ≤ +125°C		0.2		mV/°C
Total Output Variation[4]	Over Line, Load, and Temp	2.410		2.590	V
Output Noise Voltage[4]	C_{Bypass} = 1.0 µF, T_J = 25°C, 10 Hz ≤ f ≤ 10 KHz		100		µV/√Hz
Long Term Stability[4]	T_J = +125°C, 1000 Hours		5.0	25	mV
Short Circuit Current	V_{OUT} = 0.0 V			-40	mA

Note 4:This parameter, although guaranteed by design, is not 100% tested in production.

Table 4: OSCILLATOR SECTION

PARAMETER	CONDITIONS	MIN	TYP	MAX	UINITS
Output Frequency[5]	T_A = 25°C	49	52	55	KHz
Temperature Stability[5]	-40°C ≤ T_J ≤ +125°C		.04		%/°C
Ramp Amplitude	R_T/C_T Peak to Peak		0.833		Vpp

PARAMETER	CONDITIONS	MIN	TYP	MAX	UINITS
Clock Ramp Reset Current	$V(R_T/C_T)$ = 1.5 V, T_A=25°C $V(R_T/C_T)$ = 1.5 V, Over Temp	7.7 7.2		9.0 9.5	mA mA
Voltage Stability	4.5 V $\leq V_{DD} \leq$ 5.5 V 3.0 V $\leq V_{DD} \leq$ 4.5 V			0.5 1.0	% %

Note 5: Output Frequency equals oscillator frequency for the GMT38LV53 series. Output frequency of the GMT38LV55 series is half the oscillator frequency.

Table 5: ERROR AMPLIFIER SECTION

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Feedback Voltage	V_{Comp} = 1.25 V	1.21	1.25	1.29	V
Input Bias Current	$V_{Feedback}$ = 1.5 V	-200	0.0	+200	nA
Open Loop Gain	1.0 V $\leq V_{Comp} \leq$ 1.5 V	70			dB
Unity Gain Bandwidth[4]		0.7			MHz
Power Supply Rejection	4.5 V $\leq V_{DD} \leq$ 5.5 V 3.0 V $\leq V_{DD} \leq$ 4.5 V	60 40			dB dB
Output Sink Current	$V_{Feedback}$ = 1.5 V,V_{Comp} = 1.0 V	0.5			mA
Output Source Current	$V_{Feedback}$ = 1.0 V,V_{Comp} = 4.0 V	-0.5			mA
Output High Level	$V_{Feedback}$ =1.5 V,R_L=15 K to Gnd	4.0			V
Output Low Level	$V_{Feedback}$ =1.5 V,R_L=15 K to V_{Ref}			1.0	V

Table 6: CURRENT SENSE AMPLIFIER SECTION

PARAMTER	CONDITIONS	MIN	TYP	MAX	UNITS
Amplifier Gain[6,7]		2.85	3.0	3.15	V/V
Current Limit Trip Point[6]	V_{Comp}= 4.0 V	0.9	1.0	1.1	V
Power Supply Rejection[6]	4.5 V ≤V_{DD} ≤ 5.5 V 3.0 V ≤V_{DD} ≤ 4.5 V		70 50		dB dB
Input Bias Current		-200	0.0	+200	nA
Delay to Output	$V(I_{Sns})$ = 0.0 V to 2.0 V, V_{Out} = 50%		50	100	nS

Note 6: Parameter is measured at the trip point of the latch with V_{Comp} = 0.0 V.

Note 7: Gain is defined as A = $\Delta V_{Comp}/V_{Th}(I_{Sns})$, where 0.0 V ≤ $V_{Th}(I_{Sns})$ ≤ 0.8 V.

Table 7: PULSE WIDTH MODULATOR SECTION

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Maximum Duty Cycle at 500 KHz	38LV53 Series 38LV55 Series	90 45	95 48		% %
Minimum Duty Cycle	All Devices			0.0	%

Table 8: OUTPUT SECTION

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
High Output Voltage	4.5 V ≤V_{DD} ≤ 5.5 I_{SOURCE} = 10 mA 3.0 V ≤V_{DD} ≤ 4.5 V I_{SOURCE} = 10 mA	 V_{DD}-.5 V_{DD}-.7		 V_{DD} V_{DD}	 V V
Low Output Voltage	4.5 V ≤V_{DD} ≤ 5.5 V I_{SINK} = 10 mA 3.0 V ≤V_{DD} ≤ 4.5 V I_{SINK} = 10 mA	 0.0 0.0		 0.5 0.7	 V V

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Risetime - 10% to 90%	4.5 V $\leq V_{DD} \leq$ 5.5 V, T_A = 25°C C_{LOAD} = 1000 pF 3.0 V $\leq V_{DD} \leq$ 4.5 V, T_A = 25°C C_{LOAD} = 1000 pF		18 36	45 90	nS nS
Falltime - 90% to 10%	4.5 V $\leq V_{DD} \leq$ 5.5 V, T_A = 25°C C_{LOAD} = 1000 pF 3.0 V $\leq V_{DD} \leq$ 4.5 V, T_A = 25°C C_{LOAD} = 1000 pF		18 36	45 90	nS nS

Table 9: UNDERVOLTAGE LOCKOUT SECTION

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Start Threshold		3.7	4.0	4.3	V
UVLO Threshold		2.50	2.75	3.00	V
Pre-start Current	V_{DD} < Start Threshold		50	100	µA
Operating Supply Current	Static operation; CT shorted to ground		1.0		mA

Table 10: ISSP* CIRCUITRY OPERATIONAL PARAMETERS

On/Off Ratio (Factory Fixed)	1:15 Where 1 = one clock cycle time of selected Fs
Trip Point	Vcomp $\geq$ 2.5 V TYPICAL

ISSP CIRCUIT OPERATION

During normal PWM operation, the COMP voltage, which is the ERROR AMP output, controls the Duty Cycle of the PWM. The COMP voltage will range from approximately 0.0 volts to Vcc of the PWM. The zero condition represents 0 duty cycle, which means the PWM is OFF. The MAXIMUM duty cycle occurs when Vcomp is just below 2.5 V. Note that Vcomp is internally divided to properly scale to the Isns comparator input.

As the COMP pin voltage varies according to the Feedback signal, it is compared to the Isns voltage within the Isns comparator. When these two voltages intersect, the output pulse is terminated until the next cycle. This is pulse-by-pulse current limiting, and is the normal current limiting function of the PWM.

When a short circuit is applied to the converter output, the ERROR AMP output responds by increasing the Duty cycle to compensate for the sagging output voltage. This is the sensed signal which trips the ISSP circuitry. The actual trip point is when Vcomp reaches approximately 2.5 V. At this point, the PWM output immediately switches into a reduced duty cycle mode, and the output drive goes into a 1:15 ON/OFF time ratio, whose absolute time values are multiples of a single oscillator cycle. Since 100 mV of hysterisis is built-in to avoid noise triggering, normal operation will resume when Vcomp drops below 2.4 V. The protective, low D mode can run for an indefinite period of time. The 1:15 ON/OFF ratio is fixed at the factory, and is not user selectable.

This new GMT approach provides a new level of operational safety for your converter designs. The ISSP circuitry is completely transparent to the user, and requires no external RC components to operate. Please contact the factory for additional ON/OFF timing ratios and options.

LIFE SUPPORT USAGE POLICY:

GMT's products are not authorized for use as critical components in life support devices or systems without the express written approval of the CEO of GMT. As used herein:
(a) Life support devices or systems are devices or systems which (1) are intended for surgical implant into the body, or (2) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
(b) A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system.

GMT Microelectronics Corporation
950 Rittenhouse Road
Norristown, PA 19403

Toll Free: (888) GMT-4771
Ph: (610) 728-9300
Fax: (610) 676-7066

E-Mail: marketing @ gmtme.com
Website: www.gmtme.com

Sales Offices

GMT Microelectronics
6 Journey
Suite 230
Aliso Viejo, CA 92656
(949) 425-3756
Fax (949) 425-3767

GMT Microelectronics
17218 Preston Road
Suite 400
Dallas, TX 75287
(972) 735-3155
Fax (972) 735-3156

GMT Microelectronics
14502 North Dale Mabry
Suite 400
Tampa, FL 33618
(813) 908-9544
Fax (813) 908-7683

GMT Microelectronics Singapore
No. 25, #05-02
Woodlands Industrial Park E1
Singapore 757743
(65) 368-6266
Fax (65) 368-6166

Great Mixed Signal Technologies

GMT38LV5x
5 Volt Current-Mode PWM Controller With ISSP

Specification Deviation

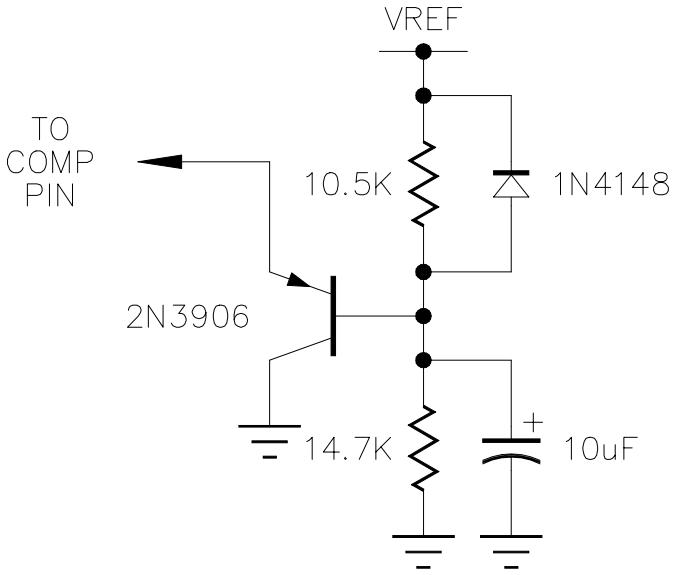
The present version of the GMT38LV5x silicon has an internal design flaw which results in improper operation of the ISSP function. GMT has taken corrective action for the next device revision.

The ISSP feature allows a voltage converter to operate under an indefinite short circuit condition. This protective mode is activated when the error amplifier output (COMP) crosses approximately 2.5V, forcing a limited duty cycle.

Application Considerations

Evaluation of the present revision of the GMT38LV5x, as a low voltage PWM, can be realized with the following modifications. This modification will prevent the ISSP feature from engaging and eliminate any possible undesirable effects. The final revision of the GMT38LV5x will not require this modification and can be omitted from any circuit layout.

Application Modifications



This circuit provides a time-dependent clamp voltage at the comp pin of the low-voltage PWM (soft-start). The resistor values are chosen such that the comp pin can never rise to a level that will trigger the ISSP function. When a fully functional part is available, the ISSP function can be utilized by increasing the value of the 14.7K resistor to 18.2K.