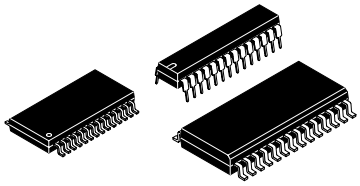


SLUS318B – APRIL 1999 – REVISED JANUARY 2002

BRUSHLESS DC MOTOR CONTROLLER

FEATURES

- **Two-Quadrant and Four-Quadrant Operation**
- **Integrated Absolute Value Current Amplifier**
- **Pulse-by-Pulse and Average Current Sensing**
- **Accurate, Variable Duty-Cycle Tachometer Output**
- **Trimmed Precision Reference**
- **Precision Oscillator**
- **Direction Output**

DESCRIPTION

The UCC3626 motor controller device combines many of the functions required to design a high-performance, two- or four-quadrant, three-phase, brushless dc motor controller into one package. Rotor position inputs are decoded to provide six outputs that control an external power stage. A precision triangle oscillator and latched comparator provide PWM motor control in either voltage- or current-mode configurations. The oscillator is easily synchronized to an external master clock source via the SYNCH input. Additionally, a QUAD select input configures the chip to modulate either the low-side switches only, or both upper and lower switches, allowing the user to minimize switching losses in less demanding two-quadrant applications.

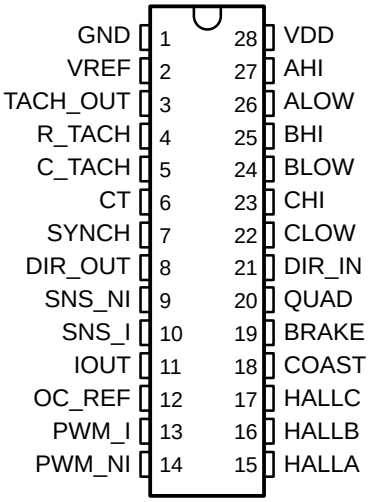
The device includes a differential current-sense amplifier and absolute-value circuit which provide an accurate reconstruction of motor current, useful for pulse-by-pulse overcurrent protection, as well as closing a current control loop. A precision tachometer is also provided for implementing closed-loop speed control. The TACH_OUT signal is a variable duty-cycle, frequency output, which can be used directly for digital control or filtered to provide an analog feedback signal. Other features include COAST, BRAKE, and DIR_IN commands, along with a direction output, DIR_OUT.

AVAILABLE OPTIONS

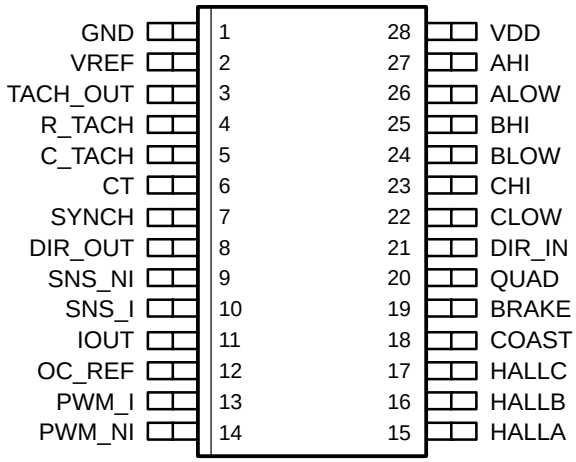
T_A	PACKAGED DEVICES		
	PDIP (N)	SOIC† (DW)	TSSOP† (PW)
–40°C to 85°C	UCC2626N	UCC2626DW	UCC2626PW
0°C to 70°C	UCC3626N	UCC3626DW	UCC3626PW

†The DW and PW packages are available taped and reeled. Add TR suffix to device type (e.g. UCC2626DWTR) to order quantities of 2,000 devices per reel.

N PACKAGE
(TOP VIEW)



DW and PW PACKAGES
(TOP VIEW)

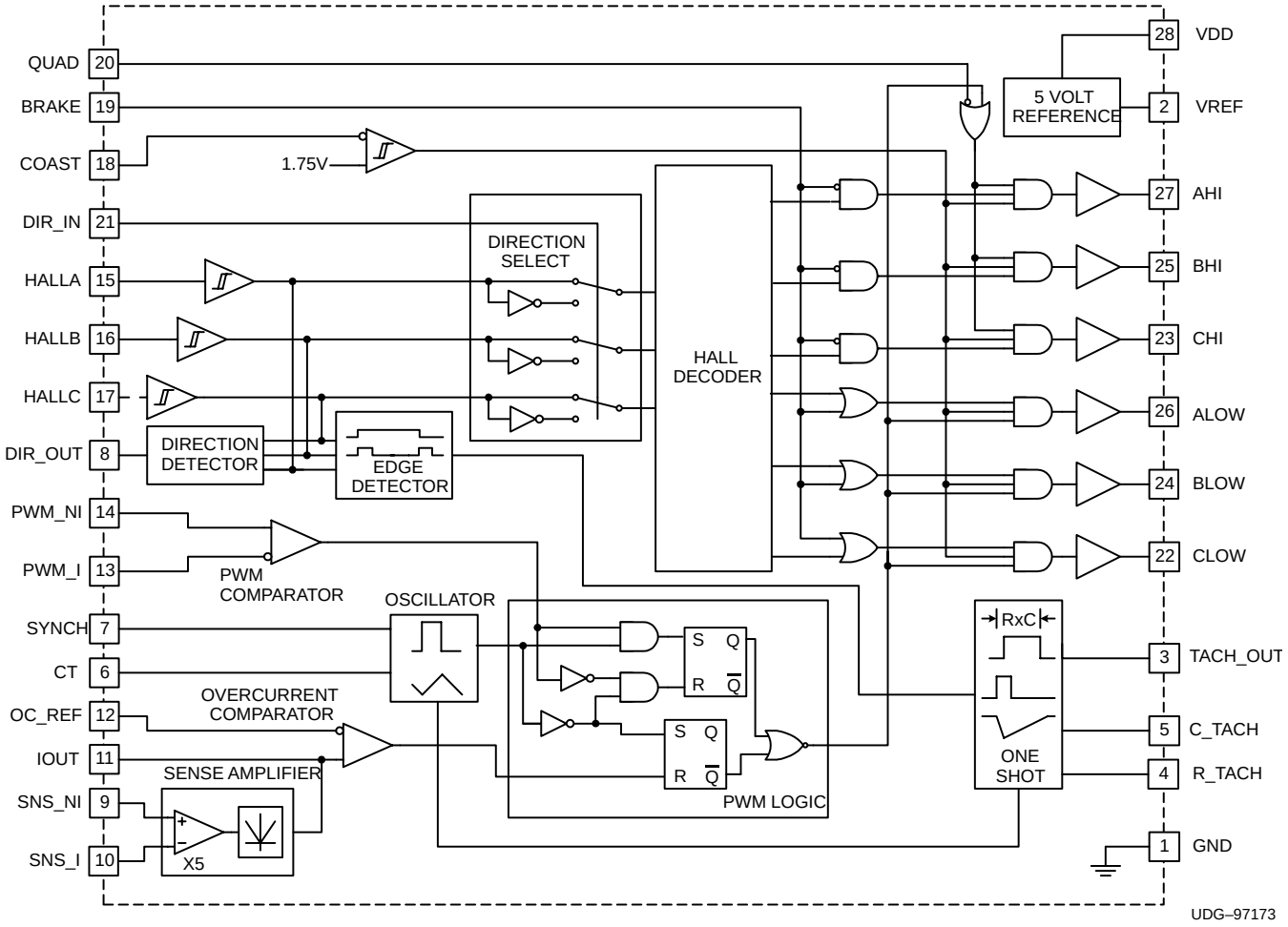


absolute maximum ratings over operating free-air temperature (unless otherwise noted)†

Supply voltage V_{DD} . . . . . 15 V
Input voltage, BRAKE, COAST, DIR_IN, HALLA, HALLB, HALLC,
OC_REF, QUAD, SYNCH, PWM_I, PWM_NI . . . . . –0.3 V to V_{DD}
SNS_I, SNS_NI . . . . . –0.5 V to V_{DD}
Output current AHI, ALOW, BHI, BLOW, CHI, CLOW . . . . . ±200 mA
DIR_OUT, IOUT, TACH_OUT, ... 1 mA
VREF . . . . . –20 mA
Junction temperature range, T_J . . . . . –55°C to 150°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C
Lead temperature soldering 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 300°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
‡ All voltages are with respect to GND. Currents are positive into negative out of the specified terminal.

block diagram



electrical characteristics over recommended operating conditions, VCC = 12 V; CT = 1 nF, R_TACH = 250 kΩ, C_TACH = 100 pF, $T_A = T_J$, T_A = –40°C to 85°C for the UCC2626, and 0°C to 70°C for the UCC3626 (unless otherwise noted)

overall

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply current	Outputs not switching	1	3	5	mA

undervoltage lockout

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Start threshold		9.0	10.5	11.0	V
UVLO hysteresis		0.35	0.40	0.50	V

5-V reference

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage	I_{VREF} = –2 mA	4.9	5	5.1	V
Line regulation voltage	11 V < VCC < 14.5 V			10	mV
Load regulation voltage	–1 mA > I_{VREF} > –5 mA			10	mV
Short circuit current		40	120	240	mA

coast input comparator

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Threshold voltage		1.60	1.75	2.00	V
Hysteresis		0.04	0.10	0.16	V

current sense amplifier

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input offset voltage		VCM = 0 V			8	mV
Input bias current		VCM = 0 V	5	10	15	µA
Gain		VCM = 0 V	4.85	5.00	5.15	V/V
PSRR		11 V < VCC < 14.5 V	60			dB
High-level output voltage		I_{IOUT}= –100 µA	6.3			V
Low-level output voltage		I_{IOUT} = 100 µA			70	mV
Output source current	UCC3626	V_{IOUT} = 2 V	500			µA
	UCC2626	V_{IOUT} = 2 V	300			µA

pwm comparator

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input common mode range		2.0		8.0	V
Propagation delay time		75		150	ns

overcurrent comparator

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input common mode range		0.0		5.0	V
Propagation delay time		50	175	250	ns

logic inputs

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
High-level logic input voltage	QUAD, BRAKE, DIR, SYNCH	3.6			V
Low-level logic input voltage	QUAD, BRAKE, DIR, SYNCH			1.4	V

electrical characteristics over recommended operating conditions, VCC = 12 V; CT = 1 nF, R_TACH = 250 kΩ, C_TACH = 100 pF, $T_A = T_J$, T_A = –40°C to 85°C for the UCC2626, and 0°C to 70°C for the UCC3626 (unless otherwise noted)

hall buffer inputs

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
High-level input voltage	HALLA, HALLB, HALLC	1.7	1.9	2.1	V
Hysteresis	HALLA, HALLB, HALLC	0.6		1.0	V
Input current	0V < VIN < 5 V		–25		µA

oscillator

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Frequency	R_{TACH} = 250 kΩ, C_T = 1nF	9.0	10.0	11.0	kHz
Frequency change with voltage	12 V < VCC < 14.5 V			3%	
CT peak voltage		7.25	7.5	7.75	V
CT peak-to-valley voltage		4.75	5.0	5.25	V
SYNCH pin minimum pulse width		500			ns

tachometer

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
High-level output voltage/VREF		I_{OUT} = –10 µA	99%		100%	
Low-level output voltage		I_{OUT} = 10 µA	0		20	mV
High-level on-resistance		I_{OUT} = –100 µA		1	1.5	kΩ
Low-level on-resistance		I_{OUT} = 100 µA		1	1.5	kΩ
High-level ramp threshold voltage				2.5		V
Ramp voltage			2.375	2.500	2.625	V
C_{TACH} charge current		R_{TACH} = 49.9 kΩ	48	51	53	µA
On-time accuracy	UCC3626	See Note 1	–3%		3%	
	UCC2626	See Note 1	–4%		3%	

direction output

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
High-level output voltage	I_{OUT} = –100 µA	4.5		5.2	V
Low-level output voltage	I_{OUT} = 100 µA	0		0.5	V

output

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Maximum duty cycle				100%	
Low-level output voltage	I_{OUT} = 2 mA	0.0	0.1	0.5	V
	I_{OUT} = 100 µA	0.0		0.1	V
High-level output voltage	I_{OUT} = –2 mA	4.0	4.8	5.2	V
	I_{OUT} = –100 µA	4.7		5.2	V
Rise and fall time	CI = 10 pF			100	ns

NOTE 1: t_{ON} is calculated using the formula $t_{ON} = \frac{C_{TACH} \times (V_{HI} - V_{LO})}{I_{CHARGE}}$

pin descriptions

AHI, BHI, CHI: Digital outputs used to control the high-side switches in a three-phase inverter. For specific decoding information reference Table I.

ALOW, BLOW, CLOW: Digital outputs used to control the low-side switches in a three-phase inverter. For specific decoding information reference Table I.

BRAKE: BRAKE is a digital input which causes the device to enter brake mode. In brake mode all three high-side outputs (AHI, BHI & CHI) are turned off, while all three lowside outputs (ALOW, BLOW, CLOW) are turned on. During brake mode the tachometer output remains operational. The only conditions that can inhibit the low-side commands during brake are UVLO, exceeding peak current, the output of the PWM comparator, or the COAST command.

COAST: The COAST input consists of a hysteretic comparator which disables the outputs. The input is useful in implementing an overvoltage bus clamp in four-quadrant applications. The outputs are disabled when the input is above 1.75 V.

CT: This pin is used in conjunction with the R_TACH pin to set the frequency of the oscillator. A timing capacitor is normally connected between this point and ground and is alternately charged and discharged between 2.5 V and 7.5 V.

C_TACH: A timing capacitor is connected between this pin and ground to set the width of the TACH_OUT pulse. The capacitor is charged with a current set by the resistor on pin R_TACH .

DIR_IN: DIR_IN is a digital input which determines the order in which the HALLA, HALLB, and HALLC inputs are decoded. For specific decode information reference Table I.

DIR_OUT: DIR_OUT represents the actual direction of the rotor as decoded from the HALLA, HALLB, and HALLC inputs. For any valid combination of HALLA, HALLB, and HALLC inputs there are two valid transitions; one of which translates to a clockwise rotation and another which translates to a counterclockwise rotation. The polarity of DIR_OUT is the same as DIR_IN while motoring, (i.e. sequencing from top to bottom in Table 1.)

GND: GND is the reference ground for all functions of the part. Bypass and timing capacitors should be terminated as close as possible to this point.

HALLA, HALLB, HALLC: These three inputs are designed to accept rotor position information positioned 120° apart. For specific decode information reference Table I. These inputs should be externally pulled up to VREF or another appropriate external supply.

IOUT: IOUT represents the output of the current sense and absolute value amplifiers. The output signal appearing is a representation of the following expression:

$$I_{OUT} = ABS\left(I_{SNS\_I} - I_{SNS\_NI}\right) \times 5$$

This output can be used to close a current control loop as well as provide additional filtering of the current sense signal.

OC_REF: OC_REF is an analog input which sets the trip voltage of the overcurrent comparator. The sense input of the comparator is internally connected to the output of the current sense amplifier and absolute value circuit.

PWM_NI: PWM_NI is the noninverting input to the PWM comparator.

PWM_I: PWM_I is the inverting input to the PWM comparator.

QUAD: The QUAD input selects between two-quadrant operation (QUAD = 0) and four-quadrant operation (QUAD = 1) . When in two-quadrant mode, only the low-side devices are effected by the output of the PWM comparator. In four-quadrant mode both high- and low-side devices are controlled by the PWM comparator.

pin descriptions

SYNCH: The SYNCH input is used to synchronize the PWM oscillator with an external digital clock. When using the SYNCH feature, a resistor equal to R_TACH must be placed in parallel with CT. When not using the SYNCH feature, SYNCH must be grounded.

SNS_NI, SNS_I: These inputs are the noninverting and inverting inputs to the current sense amplifier, respectively. The integrated amplifier is configured for a gain of five. An absolute value function is also incorporated into the output in order to provide a representation of actual motor current when operating in four-quadrant mode.

TACH_OUT: TACH_OUT is the output of a monostable triggered by a change in the commutation state, thus providing a variable duty cycle, frequency output. The on time of the monostable is set by the timing capacitor connected to C_TACH. The monostable is capable of being retriggered if a commutation occurs during its on-time.

R_TACH: A resistor connected between R_TACH and ground programs the current for both the oscillator and tachometer.

VDD: VDD is the input supply connection for this device. Undervoltage lockout keeps the outputs off for inputs below 10.5 V. The input should be bypassed with a 0.1-µF ceramic capacitor, minimum.

VREF: VREF is a 5-V, 2% trimmed reference output with 5 mA of maximum available output current. This pin should be bypassed to ground with a ceramic capacitor with a value of at least 0.1 µF.

APPLICATION INFORMATION

Table 1 provides the decode logic for the six outputs, AHI, BHI, CHI, ALOW, BLOW, and CLOW as a function of the BRAKE, COAST, DIR_IN, HALLA, HALLB, and HALLC inputs.

Table 1. Commutation Truth Table

BRAKE	COAST	DIR_IN	HALL INPUTS			HIGH-SIDE OUTPUTS			LOW-SIDE OUTPUTS		
			A	B	C	A	B	C	A	B	C
0	0	1	1	0	1	1	0	0	0	1	0
0	0	1	1	0	0	1	0	0	0	0	1
0	0	1	1	1	0	0	1	0	0	0	1
0	0	1	0	1	0	0	1	0	1	0	0
0	0	1	0	1	1	0	0	1	1	0	0
0	0	1	0	0	1	0	0	1	0	1	0
0	0	0	1	0	1	0	1	0	1	0	0
0	0	0	0	0	1	0	1	0	0	0	1
0	0	0	0	1	1	1	0	0	0	0	1
0	0	0	0	1	0	1	0	0	0	1	0
0	0	0	1	1	0	0	0	1	0	1	0
0	0	0	1	0	0	0	0	1	1	0	0
X	1	X	X	X	X	0	0	0	0	0	0
1	0	X	X	X	X	0	0	0	1	1	1
0	0	X	1	1	1	0	0	0	0	0	0
0	0	X	0	0	0	0	0	0	0	0	0

APPLICATION INFORMATION

The UCC3626 is designed to operate with 120° position sensor encoding. In this format, the three position sensor signals are never simultaneously high or low. Motors whose sensors provide 60° encoding, can be converted to 120° using the circuit shown in Figure 1.

In order to prevent noise from commanding improper commutation states, some form of low-pass filtering on HALLA, HALLB, and HALLC is recommended. Passive RC networks generally work well and should be located as close as possible to the device. Figure 2 illustrates these techniques.

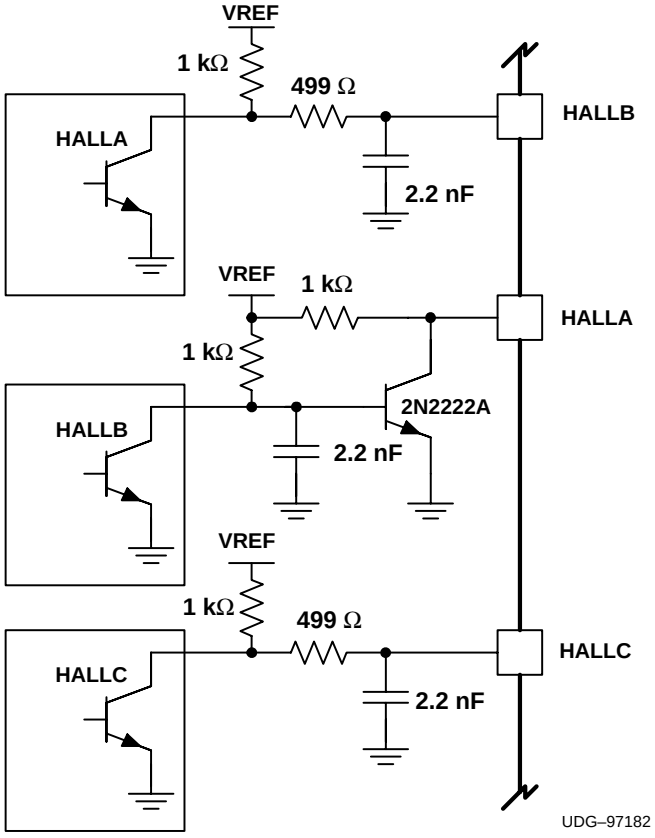


Figure 1. Converting Hall Code From 60° to 120°

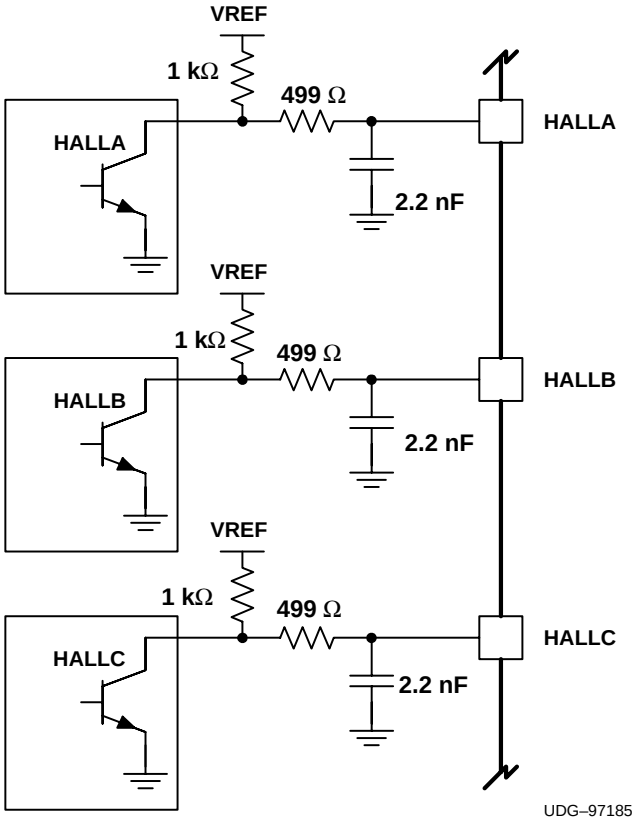


Figure 2. Passive Hall Filtering Technique

APPLICATION INFORMATION

configuring the oscillator

The UCC3626 oscillator is designed to operate at frequencies up to 250 kHz and provide a triangle waveform on CT with a peak-to-peak amplitude of 5 V for improved noise immunity. The current used to program CT is derived from the R_TACH resistor according to the following equation:

$$I_{OSC} = \frac{25}{R\_TACH} \text{ Amps} \quad (1)$$

The oscillator frequency is set by R_TACH and CT according to the following relationship:

$$f_{OSC} = \frac{2.5}{R\_TACH \times CT} \text{ Hz} \quad (2)$$

Timing resistor values should be between 25 kΩ and 500 kΩ, while capacitor values should be between 100 pF and 1 μF. Figure 3 provides a graph of oscillator frequency for various combinations of timing components. As with any high-frequency oscillator, timing components should be located as close as possible to the device pins when laying out the printed-circuit board. It is also important to reference the timing capacitor directly to the ground pin on the UCC3626 rather than daisy chaining it to another trace or the ground plane. This technique prevents switching current spikes in the local ground from causing jitter in the oscillator.

synchronizing the oscillator

A common system specification is to have all oscillators synchronized to a master clock. The UCC3626 provides a SYNCH input for this purpose. The SYNCH input is designed to interface with a digital clock pulse generated by the master oscillator. A positive-going edge on this input causes the UCC3626 oscillator to begin discharging. In order for the slave oscillator to function properly, it must be programmed for a frequency slightly lower than that of the master. Also, a resistor equal to R_TACH must be placed in parallel with CT. Figure 4 illustrates the waveforms for a slave oscillator programmed to 20 kHz with a master frequency of 30 kHz. The SYNCH pin must be grounded when not used.

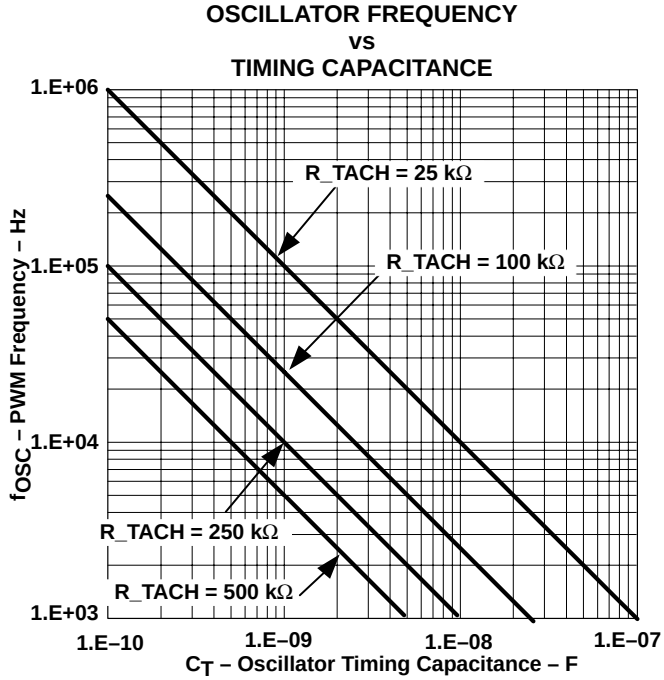


Figure 3

APPLICATION INFORMATION

programming the tachometer

The UCC3626 tachometer consists of a precision 5-V monostable, triggered by either a rising or falling edge on any of the three Hall inputs, HALLA, HALLB, and HALLC. The resulting TACH_OUT waveform is a variable duty-cycle square wave whose frequency is proportional to motor speed, as given by:

$$\text{TACH\_OUT} = \frac{V \times P}{20} \text{ Hz} \quad (3)$$

where P is the number of motor pole pairs and V is motor velocity in RPM.

The on time of the monostable is programmed via timing resistor R_TACH and capacitor C_TACH according to the following equation:

$$t_{ON} = \text{R\_TACH} \times \text{C\_TACH} \text{ sec} \quad (4)$$

Figure 5 provides a graph of on times for various combinations of R_TACH and C_TACH. On time is typically set to a value less than the minimum TACH_OUT period as given by:

$$t_{PERIOD\ (min)} = \frac{20}{V_{MAX} \times P} \text{ sec} \quad (5)$$

where P is the number of motor pole pairs and V is motor velocity in RPM.

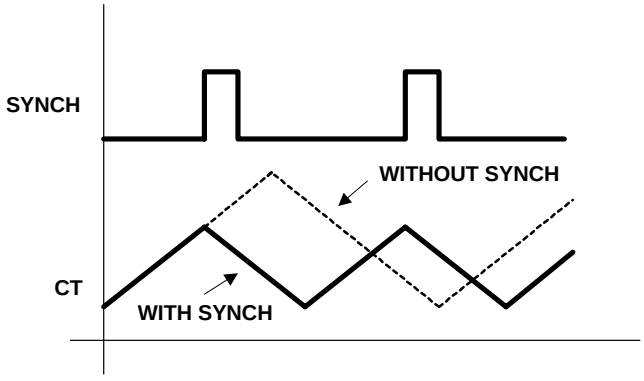


Figure 4. Oscillator Waveforms

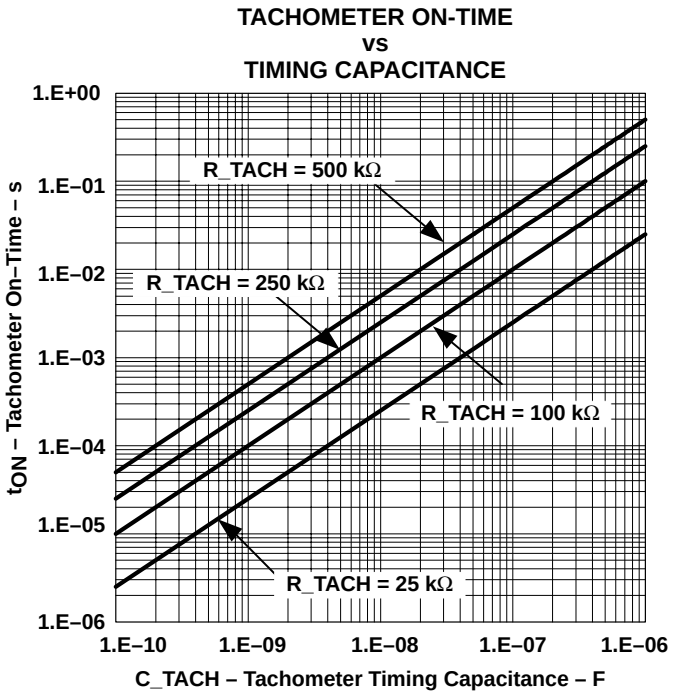


Figure 5

APPLICATION INFORMATION

The TACH_OUT signal can be used to close a digital velocity loop using a microcontroller, as shown in Figure 6, or directly low-pass filtered in an analog implementation, Figure 7.

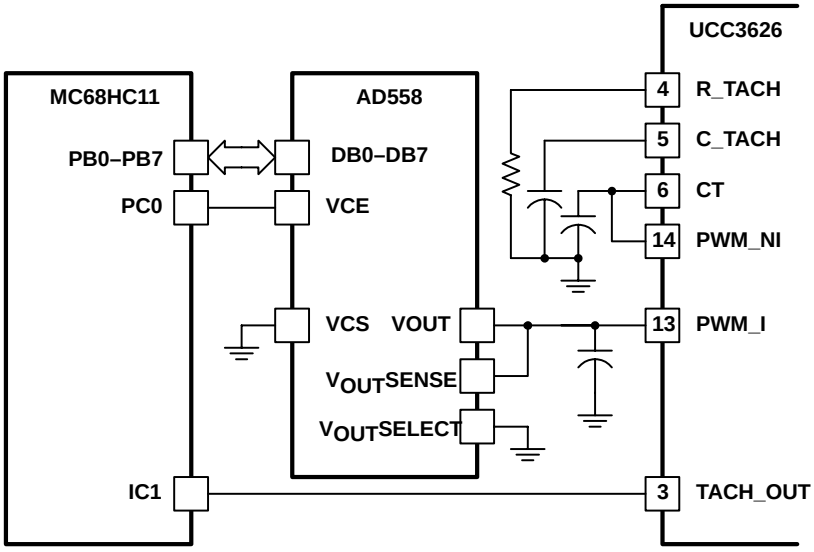


Figure 6. Digital Velocity Loop Implementation Using MC68HC11

two quadrant vs four quadrant control

Figure 8 illustrates the four possible quadrants of operation for a motor. *Two-quadrant control* refers to a system in which operation is limited to quadrants I and III (where torque and velocity are in the same direction). With a two-quadrant brushless dc amplifier, there are no provisions other than friction to decelerate the load, limiting the approach to less demanding applications. *Four-quadrant controllers*, on the other hand, provide controlled operation in all quadrants, including II and IV, where torque and rotation are of opposite direction.

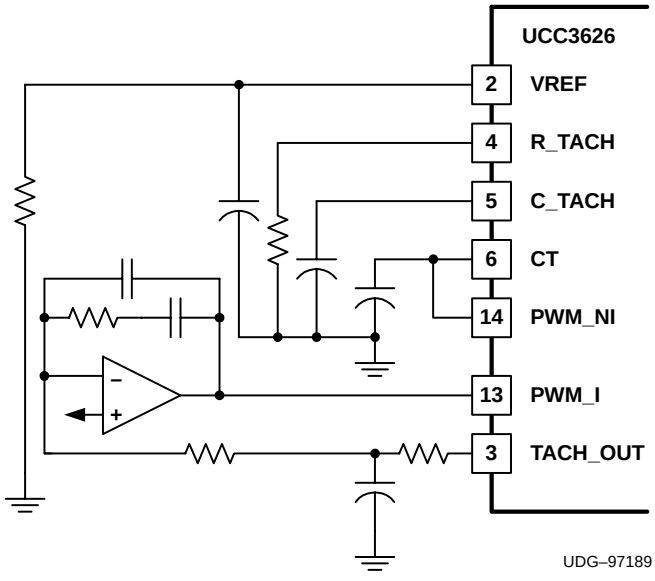


Figure 7. Simple Analog Velocity Loop

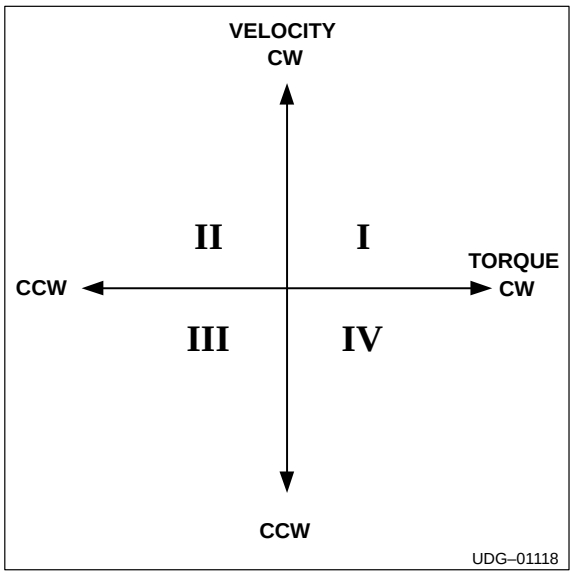


Figure 8. Four Quadrants of Operation

APPLICATION INFORMATION

When configured for two-quadrant operation, (QUAD=0), the UCC3626 modulates only the low-side devices of the output power stage. The current paths within the output stage during the PWM on- and off-times are illustrated in Figure 9. During the *on* interval, both switches are on, and current flows through the load down to ground. During the *off* time, the lower switch is shut off, and the motor current circulates through the upper half bridge via the flyback diode. The motor is assumed to be operating in either quadrant I or III.

If operation is attempted in quadrants II or IV by changing the DIR bit and reversing the torque, switches 1 and 4 are turned off and switches 2 and 3 turned on. Under this condition motor current very quickly decays, reverses direction and increases until the control threshold is reached. At this point, switch 2 turns off and current once again circulates in the upper half bridge. However, in this case, the motor's BEMF is in phase with the current, (i.e. the motor's direction of rotation has not yet changed.) Figure 10 illustrates the current paths when operating in this mode. Under these conditions there is nothing to limit the current other than motor and drive impedance. These high-circulating currents can result in damage to the power devices in addition to high, uncontrolled torque.

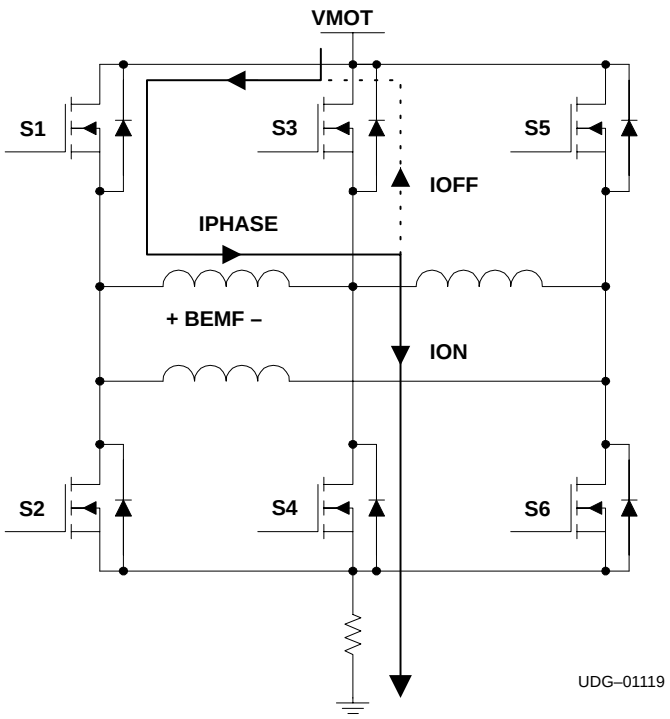


Figure 9. Two-Quadrant Chopping

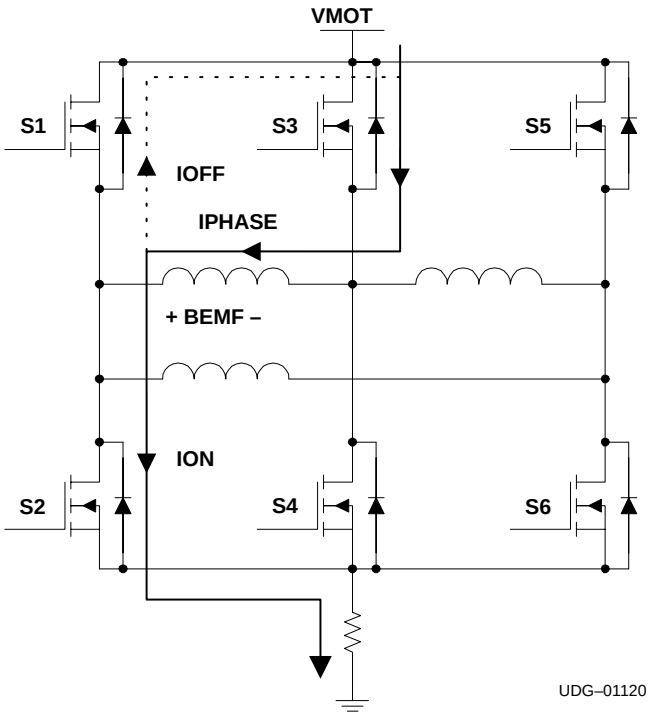


Figure 10. Two-Quadrant Reversal

APPLICATION INFORMATION

By pulse width modulating both the upper and lower power devices (QUAD=1), motor current always decays during the PWM *off* time, eliminating any uncontrolled circulating currents. In addition, current always flows through the current sense resistor, providing a suitable feedback signal. Figure 11 illustrates the current paths during a four-quadrant torque reversal. Motor drive waveforms for both two- and four-quadrant operation are illustrated in Figure 12.

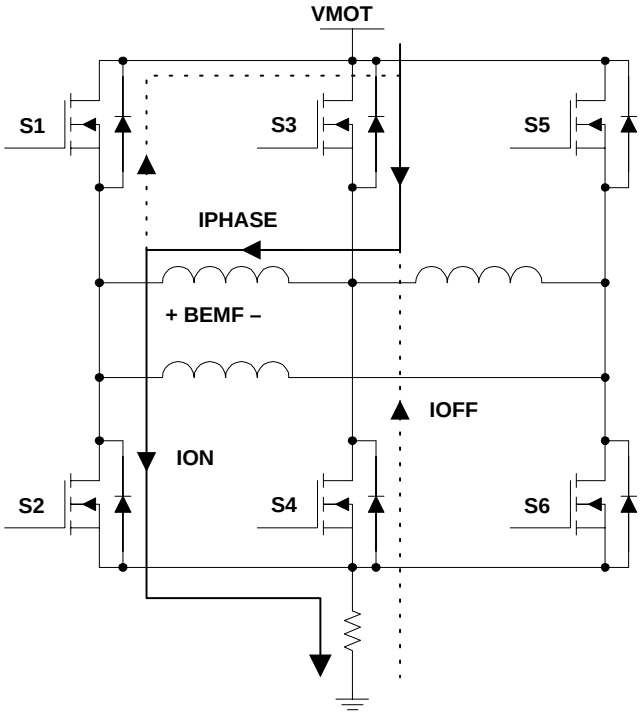


Figure 11. Four-Quadrant Reversal

APPLICATION INFORMATION

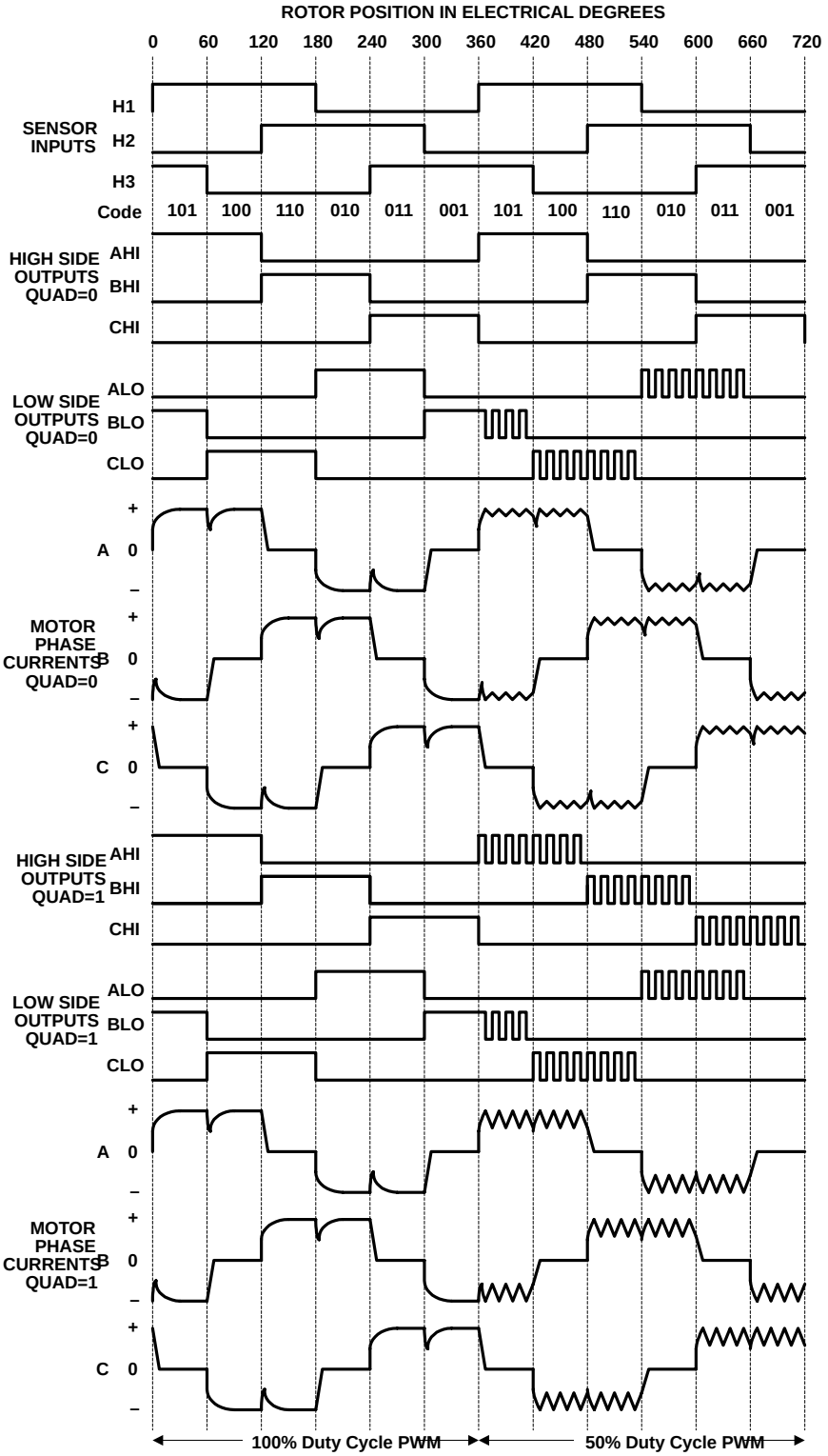


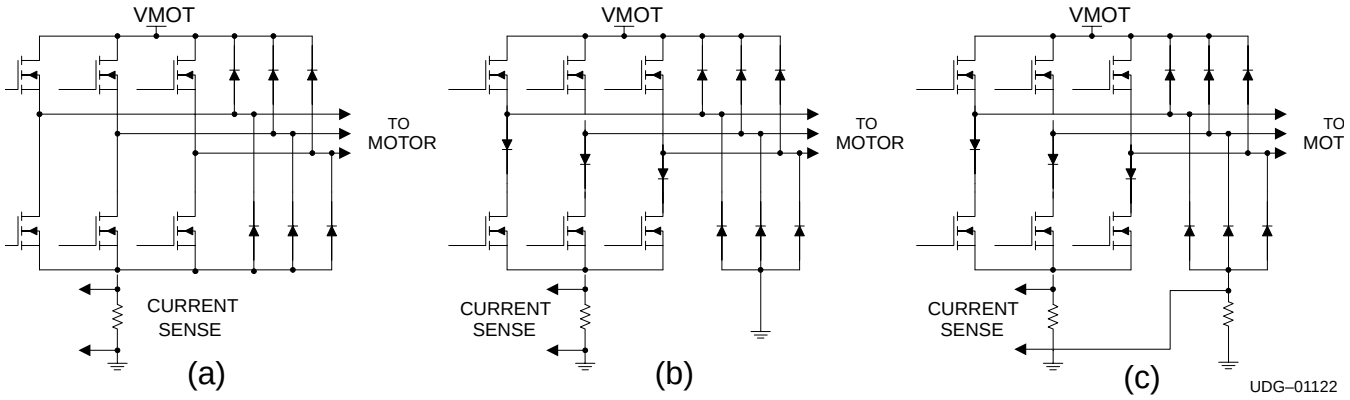
Figure 12. Motor Drive and Current Waveforms for Two-Quadrant (QUAD=0) and Four-Quadrant (QUAD=1) Operation

APPLICATION INFORMATION

power stage design considerations

The flexible architecture of the UCC3626 requires the user to pay close attention to the design of the power output stage. Two- and four-quadrant applications not requiring the brake function are able to use the power stage approach illustrated in Figure 13a. In many cases the body diode of the MOSFET can be used to reduce parts count and cost. If efficiency is a key requirement, Schottky diodes can be used in parallel with the switches.

UDG–97190



UDG–01122

	TWO QUADRANT	FOUR QUADRANT	SAFE BRAKING	POWER REVERSAL	CURRENT SENSE	
					PULSE-BY-PULSE	AVERAGE
(a)	YES	YES	NO	Four-Quad Only	YES	YES
(b)	YES	NO	YES	No	YES	NO
(c)	YES	YES	YES	Four-Quad Only	YES	YES

Figure 13. Power Stage Topologies

If the system requires a braking function, diodes must be added in series with the lower power devices and the lower flyback diodes must be returned to ground, as pictured in Figure 13b, and 13c. This requirement prevents brake currents from circulating in the lower half bridge and bypassing the sense resistor. In addition, the combination of braking and four-quadrant control necessitates an additional resistor in the diode path to sense current during the PWM *off* time as illustrated in Figure 13c.

APPLICATION INFORMATION

current sensing

The UCC3626 includes a differential current-sense amplifier with a fixed gain of five, along with an absolute value circuit. The current-sense signal should be low pass filtered to eliminate leading-edge spikes. In order to maximize performance, the input impedance of the amplifier should be balanced. If the sense voltage must be trimmed for accuracy reasons, a low-value input divider or a differential divider should be used to maintain impedance matching, as shown in Figure 14.

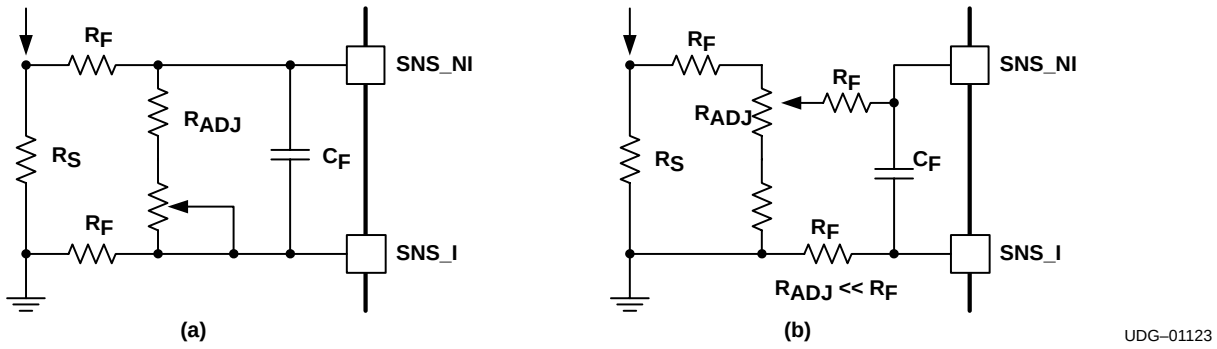


Figure 14. (a) Differential Divider and (b) Low-Value Divider

With four-quadrant chopping, motor current always flows through the sense resistor. However, during the flyback period the polarity across the sense resistor is reversed. The absolute value amplifier cancels the polarity reversal by inverting the negative sense signal during the flyback time, see Figure 15. Therefore, the output of the absolute value amplifier is a reconstructed analog of the motor current, suitable for protection as well as feedback loop closure.

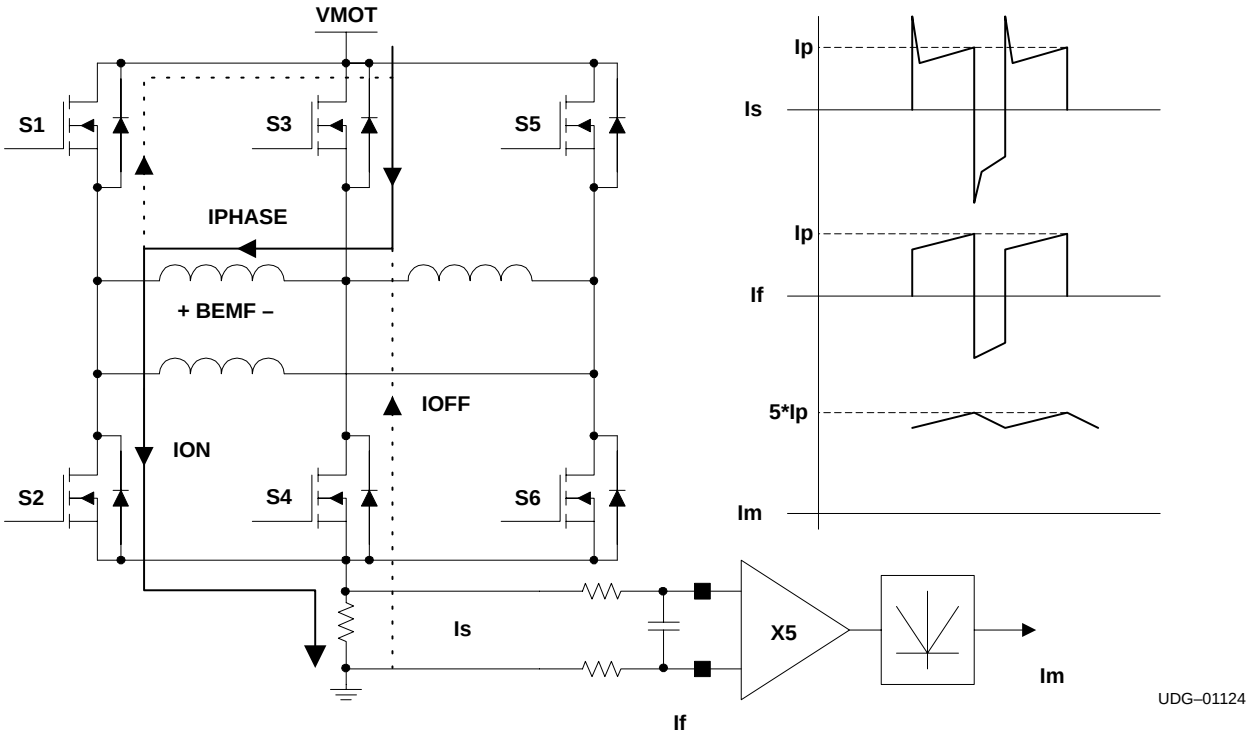


Figure 15. Current Sense Amplifier Waveform

APPLICATION INFORMATION

Figure 17 illustrates a simple 175-V, 2-A, two-quadrant velocity controller using the UCC3626. The power stage is designed to operate with a rectified off-line supply using IR2210s to provide the interface between the low voltage control signals and the power MOSFETs. The power topology illustrated in Figure 13c is implemented in order to provide braking capability.

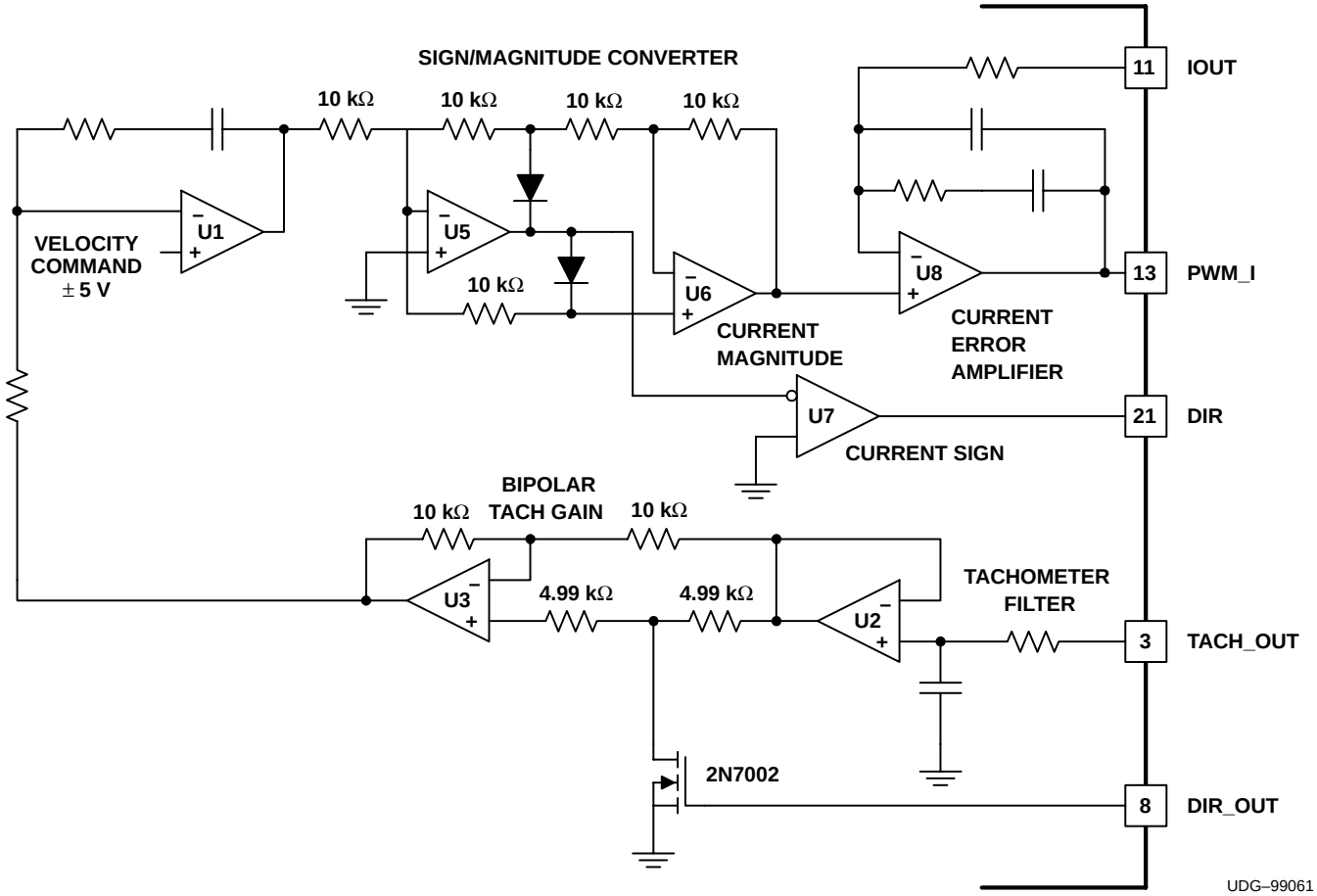


Figure 16. Four-Quadrant Control Loop

The controller's speed command is set by potentiometer R30, while the speed feedback signal is obtained by low-pass filtering and buffering the TACH_OUT signal using R11 and C9. Small signal compensation of the velocity control loop is provided by amplifier U5A, whose output is used to control the PWM duty cycle. The integrating capacitor, C8, places a pole at 0 Hz and a zero in conjunction with R10. This zero can be used to cancel the low-frequency motor pole and to cross the loop-over with a –20 dB gain response.

Four-quadrant applications require the control of motor current. Figure 16 illustrates a sign/magnitude current control loop within an outer bipolar velocity loop using the UCC3626. U1 serves as the velocity loop error amplifier and accepts a ± 5-V command signal. Velocity feedback is provided by low-pass filtering and scaling the TACH_OUT signal using U2. The direction output switch, DIR_OUT, and U3 set the polarity of the tachometer gain according to the direction of rotation. The output of the velocity error amplifier, U1, is then converted to sign/magnitude form using U5 and U6. The sign portion is used to drive the DIR input while the magnitude commands the current error amplifier, U8. Current feedback is provided by the internal current sense amplifier via the IOUT pin.

APPLICATION INFORMATION

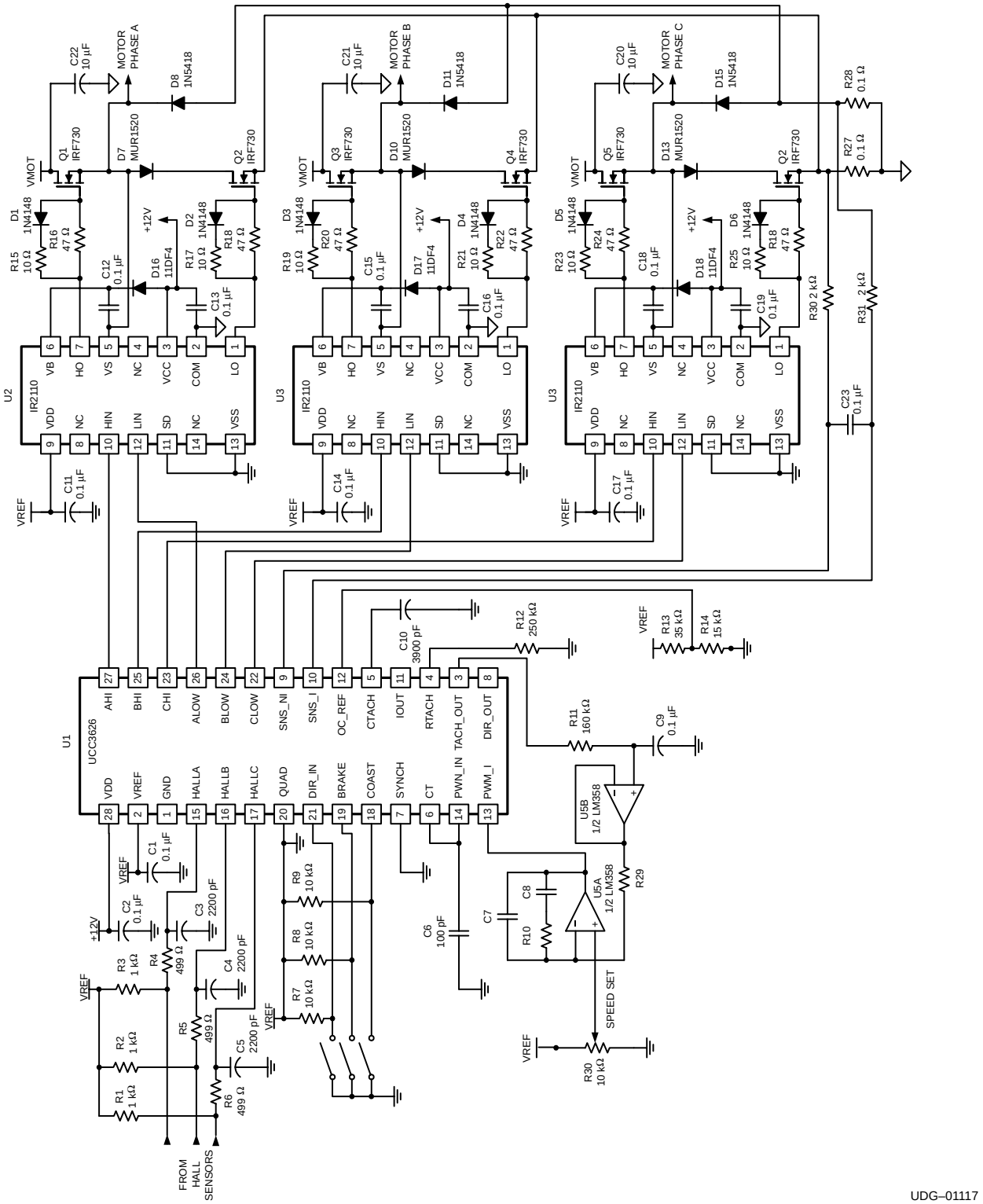


Figure 17. Two-Quadrant Velocity Controller

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
UCC2626DW	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC2626DWG4	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC2626PW	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC2626PWG4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626DW	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626DWG4	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626DWTR	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626DWTRG4	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626N	ACTIVE	PDIP	N	28	13	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
UCC3626NG4	ACTIVE	PDIP	N	28	13	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
UCC3626PW	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626PWG4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626PWTR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UCC3626PWTRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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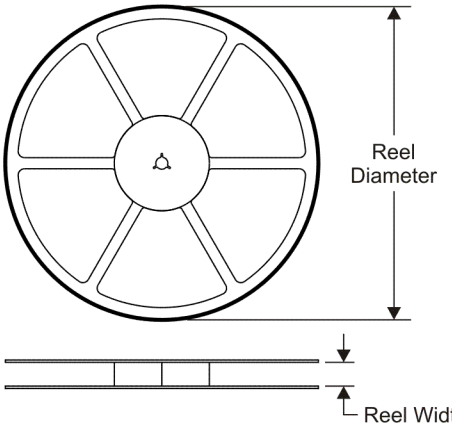
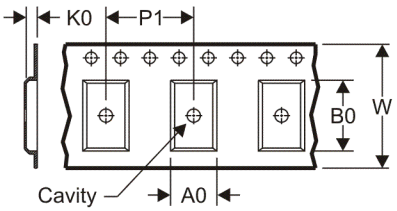
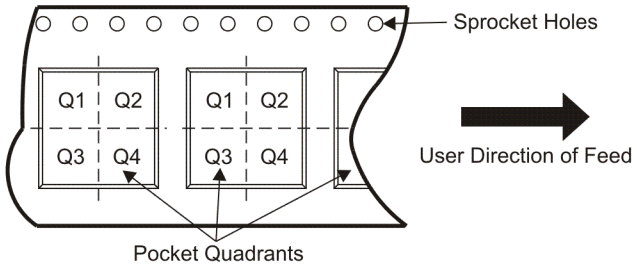


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

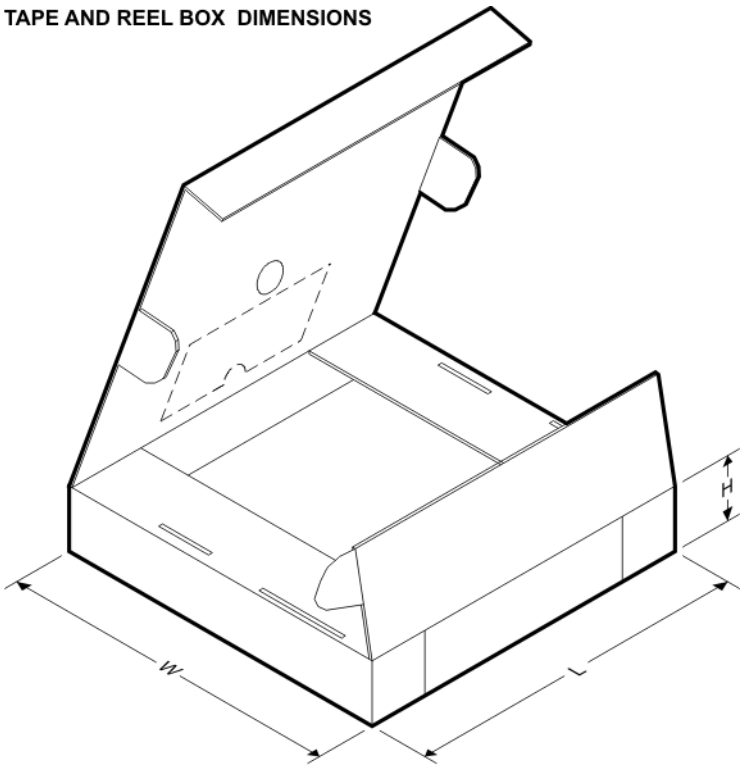
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
UCC3626DWTR	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
UCC3626PWTR	TSSOP	PW	28	2000	330.0	16.4	7.1	10.4	1.6	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UCC3626DWTR	SOIC	DW	28	1000	346.0	346.0	49.0
UCC3626PWTR	TSSOP	PW	28	2000	346.0	346.0	33.0

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