# LAMPIRAN

MICROCHIP

# dsPIC30F4011/4012

## dsPIC30F4011/4012 Enhanced Flash 16-bit Digital Signal Controller

**Note:** This data sheet summarizes features of this group of dsPIC30F devices and is not intended to be a complete reference source. For more information on the CPU, peripherals, register descriptions and general device functionality, refer to the *dsPIC30F Family Reference Manual* (DS70046). For more information on the device instruction set and programming, refer to the *dsPIC30F Programmer's Reference Manual* (DS70030).

### High Performance Modified RISC CPU:

- Modified Harvard architecture
- C compiler optimized instruction set architecture with flexible addressing modes
- 84 base instructions
- 24-bit wide instructions, 16-bit wide data path
- 48 Kbytes on-chip Flash program space (16K Instruction words)
- 2 Kbytes of on-chip data RAM
- 1 Kbytes of non-volatile data EEPROM
- Up to 30 MIPs operation:
  - DC to 40 MHz external clock input
  - 4 MHz-10 MHz oscillator input with PLL active (4x, 8x, 16x)
- 30 interrupt sources
  - 3 external interrupt sources
  - 8 user selectable priority levels for each interrupt source
  - 4 processor trap sources
- 16 x 16-bit working register array

### DSP Engine Features:

- Dual data fetch
- Accumulator write back for DSP operations
- Modulo and Bit-Reversed Addressing modes
- Two, 40-bit wide accumulators with optional saturation logic
- 17-bit x 17-bit single cycle hardware fractional/ integer multiplier
- All DSP instructions single cycle
- ± 16-bit single cycle shift

### Peripheral Features:

- High current sink/source I/O pins: 25 mA/25 mA
- Timer module with programmable prescaler:
  - Five 16-bit timers/counters; optionally pair 16-bit timers into 32-bit timer modules
- 16-bit Capture input functions
- 16-bit Compare/PWM output functions
- 3-wire SPI™ modules (supports 4 Frame modes)
- $I^2C$™ module supports Multi-Master/Slave mode and 7-bit/10-bit addressing
- 2 UART modules with FIFO Buffers
- 1 CAN modules, 2.0B compliant

### Motor Control PWM Module Features:

- 6 PWM output channels
  - Complementary or Independent Output modes
  - Edge and Center Aligned modes
- 3 duty cycle generators
- Dedicated time base
- Programmable output polarity
- Dead-time control for Complementary mode
- Manual output control
- Trigger for A/D conversions

### Quadrature Encoder Interface Module Features:

- Phase A, Phase B and Index Pulse input
- 16-bit up/down position counter
- Count direction status
- Position Measurement (x2 and x4) mode
- Programmable digital noise filters on inputs
- Alternate 16-bit Timer/Counter mode
- Interrupt on position counter rollover/underflow

# SKM25GD125D

SEMITRANS® 6

IGBT modules

**SKM25GD125D**

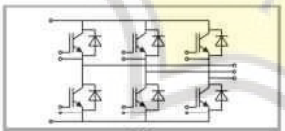
Target Data

### Features

- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability, self limiting to 6 x Icnom
- Fast & soft inverse CAL diodes
- Large clearance (10 mm) and creepage distances (20 mm)
- Isolated copper baseplate using DBC Technology (Direct Copper Bonding)
- UL recognized, file no. E63532

### Typical Applications*

- Three phase inverters for AC motor speed control
- Pulse frequencies also above 15 kHz
- DC servo and robot drives



GD

**Absolute Maximum Ratings**

| Symbol | Conditions | | Values | Unit |
|---|---|---|---|---|
| **IGBT** | | | | |
| $V_{CES}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_C$ | $T_j$ = 150 °C | $T_c$ = 25 °C | 39 | A |
| | | $T_c$ = 80 °C | 27 | A |
| $I_{Cnom}$ | | | 25 | A |
| $I_{CRM}$ | $I_{CRM}$ = 2x$I_{Cnom}$ | | 50 | A |
| $V_{GES}$ | | | -20 ... 20 | V |
| $t_{psc}$ | $V_{CC}$ = 600 V<br>$V_{GE}$ ≤ 15 V<br>$V_{CES}$ ≤ 1200 V | $T_j$ = 125 °C | 10 | µs |
| $T_j$ | | | -55 ... 150 | °C |
| **Inverse diode** | | | | |
| $I_F$ | $T_j$ = 150 °C | $T_c$ = 25 °C | 47 | A |
| | | $T_c$ = 80 °C | 32 | A |
| $I_{Fnom}$ | | | 40 | A |
| $I_{FRM}$ | $I_{FRM}$ = 2x$I_{Fnom}$ | | 80 | A |
| $I_{FSM}$ | $t_p$ = 10 ms, sin 180°, $T_j$ = 25 °C | | 410 | A |
| $T_j$ | | | -40 ... 150 | °C |
| **Module** | | | | |
| $I_{t(RMS)}$ | $T_{terminal}$ = 80 °C | | 100 | A |
| $T_{stg}$ | | | -40 ... 125 | °C |
| $V_{isol}$ | AC sinus 50 Hz, t = 1 min | | 4000 | V |

**Characteristics**

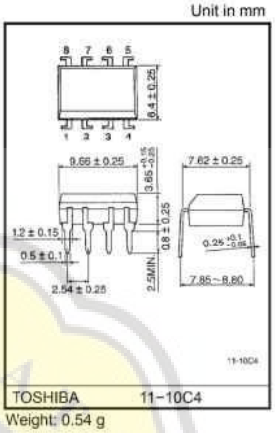
| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 25 A<br>$V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 3.20 | 3.70 | V |
| | | $T_j$ = 125 °C | | 3.60 | 4.20 | V |
| $V_{CE0}$ | chiplevel | $T_j$ = 25 °C | | 1.5 | 1.75 | V |
| | | $T_j$ = 125 °C | | 1.7 | 1.95 | V |
| $r_{CE}$ | $V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 68.00 | 78.00 | mΩ |
| | | $T_j$ = 125 °C | | 76.00 | 90.00 | mΩ |
| $V_{GE(th)}$ | $V_{GE}$=$V_{CE}$, $I_C$ = 1 mA | | 4.5 | 5.5 | 6.5 | V |
| $I_{CES}$ | $V_{GE}$ = 0 V<br>$V_{CE}$ = 1200 V | $T_j$ = 25 °C | | 0.1 | 0.3 | mA |
| | | | | | | mA |
| $C_{ies}$ | $V_{CE}$ = 25 V<br>$V_{GE}$ = 0 V | f = 1 MHz | | 1.65 | | nF |
| $C_{oes}$ | | f = 1 MHz | | 0.25 | | nF |
| $C_{res}$ | | f = 1 MHz | | 0.11 | | nF |
| $Q_G$ | $V_{GE}$ = - 8 V...+ 20 V | | | 221 | | nC |
| $R_{Gint}$ | $T_j$ = 25 °C | | | 0.00 | | Ω |
| $t_{d(on)}$ | $V_{CC}$ = 600 V<br>$I_C$ = 25 A<br>$V_{GE}$ = ±15 V<br>$R_{G\,on}$ = 16 Ω<br>$R_{G\,off}$ = 16 Ω | $T_j$ = 125 °C | | 25 | | ns |
| $t_r$ | | $T_j$ = 125 °C | | 19 | | ns |
| $E_{on}$ | | $T_j$ = 125 °C | | 3.9 | | mJ |
| $t_{d(off)}$ | | $T_j$ = 125 °C | | 184 | | ns |
| $t_f$ | | $T_j$ = 125 °C | | 8 | | ns |
| $E_{off}$ | | $T_j$ = 125 °C | | 1.6 | | mJ |
| $R_{th(j-c)}$ | per IGBT | | | | 0.56 | K/W |

TOSHIBA PHOTOCOUPLER GaAlAs IRED & PHOTO-IC

# TLP250(INV)

TRANSISTOR INVERTER
INVERTERS FOR AIR CONDITIONER
IGBT GATE DRIVE
POWER MOS FET GATE DRIVE

Unit in mm




TOSHIBA 11−10C4

Weight: 0.54 g

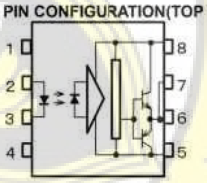
The TOSHIBA TLP250(INV) consists of a GaAlAs light emitting diode and a integrated photodetector.
This unit is 8-lead DIP.
TLP250(INV) is suitable for gate driving circuit of IGBT or power MOS FET.

- Input Threshold Current : $I_F$=5mA(MAX)
- Supply Current(ICC) : 11mA(MAX)
- Supply Voltage(VCC) : 10~35V
- Output Current(IO) : ±2.0A(MAX)
- Switching Time(tpLH/tpHL) : 0.5μs(MAX)
- Isolation Voltage : 2500Vrms
- UL Recognized : UL1577,File No.E67349
- Option(D4)
  VDE Approved : DIN VDE0884/06.92 Certificate No.76823
  Maximum Operating Insulation Voltage : 630$V_{PK}$
  Highest Permissible Over Voltage : 4000$V_{PK}$
  **(Note):When a VDE0884 approved type is needed, Please designate the "Option(D4)"**
- Creepage Distance : 6.4mm(MIN)
  Clearance : 6.4mm(MIN)

## TRUTH TABLE

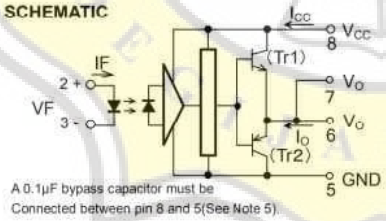
| | | Tr 1 | Tr 2 |
|---|---|---|---|
| INPUT LED | ON | ON | OFF |
| | OFF | OFF | ON |

## PIN CONFIGURATION(TOP VIEW)




1:N.C.
2: ANODE
3:CATHODE
4:N.C.
5:GND
6:VO(OUTPUT)
7:VO
8:VCC

## SCHEMATIC




A 0.1μF bypass capacitor must be Connected between pin 8 and 5(See Note 5).

# Octal buffer/line driver; 3-state 74HC/HCT541

## FEATURES

- Non-inverting outputs
- Output capability: bus driver
- $I_{CC}$ category: MSI

## GENERAL DESCRIPTION

The 74HC/HCT541 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT541 are octal non-inverting buffer/line drivers with 3-state outputs. The 3-state outputs are controlled by the output enable inputs $\overline{OE}_1$ and $\overline{OE}_2$. A HIGH on $\overline{OE}_n$ causes the outputs to assume a high impedance OFF-state.
The "541" is identical to the "540" but has non-inverting outputs.

## QUICK REFERENCE DATA

GND = 0 V; $T_{amb}$ = 25 °C; $t_r = t_f$ = 6 ns

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | | UNIT |
|---|---|---|---|---|---|
| | | | HC | HCT | |
| $t_{PHL}/t_{PLH}$ | propagation delay $A_n$ to $Y_n$ | $C_L$ = 15 pF; $V_{CC}$ = 5 V | 10 | 12 | ns |
| $C_I$ | input capacitance | | 3.5 | 3.5 | pF |
| $C_{PD}$ | power dissipation capacitance per buffer | notes 1 and 2 | 37 | 39 | pF |

**Notes**

1. $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in µW):
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ where:
   $f_i$ = input frequency in MHz
   $f_o$ = output frequency in MHz
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs
   $C_L$ = output load capacitance in pF
   $V_{CC}$ = supply voltage in V
2. For HC the condition is $V_I$ = GND to $V_{CC}$
   For HCT the condition is $V_I$ = GND to $V_{CC}$ – 1.5 V

## ORDERING INFORMATION

See *"74HC/HCT/HCU/HCMOS Logic Package Information"*.

# Current Transducer LA 55-P

$I_{PN}$ = 50 A

For the electronic measurement of currents: DC, AC, pulsed..., with galvanic separation between the primary circu t and the secondary circuit.

## Electrical data

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $I_{PN}$ | Primary nominal RMS current | | | | 50 | | | A |
| $I_{PM}$ | Primary current, measuring range | | | | 0 ... ±70 | | | A |
| $R_M$ | Measuring resistance | | @ $T_A$ = 70 °C | | $T_A$ = 85 °C | | | |
| | | | $R_{M\,min}$ | $R_{M\,max}$ | $R_{M\,min}$ | $R_{M\,max}$ | | |
| | with ±12 V | @ ±50 $A_{max}$ | 10 | 100 | 60 | 95 | | Ω |
| | | @ ±70 $A_{max}$ | 10 | 50 | 60 [1] | 60 [1] | | Ω |
| | with ±15 V | @ ±50 $A_{max}$ | 50 | 160 | 135 | 155 | | Ω |
| | | @ ±70 $A_{max}$ | 50 | 90 | 135 [2] | 135 [2] | | Ω |
| $I_{SN}$ | Secondary nominal RMS current | | | | 50 | | | mA |
| $N_P/N_S$ | Turns ratio | | | | 1 : 1000 | | | |
| $U_C$ | Supply voltage (±5 %) | | | | ±12 ... 15 | | | V |
| $I_C$ | Current consumption (±2) | | | | 10 (@ ±15 V) + $I_S$ | | | mA |

## Accuracy - Dynamic performance data

| | | | | | |
|---|---|---|---|---|---|
| $\varepsilon$ | Error @ $I_{PN}$, $T_A$ = 25 °C | @ ±15 V (±5 %) | ±0.65 | | % |
| | | @ ±12 ... 15 V (±5 %) | ±0.90 | | % |
| $\varepsilon_L$ | Linearity error | | < 0.15 | | % |
| | | | Typ | Max | |
| $I_O$ | Offset current @ $I_P$ = 0, $T_A$ = 25 °C | | | ±0.2 | mA |
| $I_{OM}$ | Magnetic offset current [3] @ $I_P$ = 0 and specified $R_M$, after an overload of 3 × $I_{PN}$ | | | ±0.3 | mA |
| $I_{OT}$ | Temperature variation of $I_O$ | −25 °C ... +85 °C | ±0.1 | ±0.6 | mA |
| | | −40 °C ... −25 °C | ±0.2 | ±1.0 | mA |
| $t_{D10}$ | Delay time @ 10 % of $I_{PN}$ | | < 500 | | ns |
| $t_{D10}$ | Delay time to 90 % of $I_{PN}$ [4] | | < 1 | | µs |
| $BW$ | Frequency bandwidth (−1 dB) | | DC ... 200 | | kHz |

## General data

| | | | | | |
|---|---|---|---|---|---|
| $T_A$ | Ambient operating temperature | | −40 ... +85 | | °C |
| $T_S$ | Ambient storage temperature | | −40 ... +90 | | °C |
| $R_S$ | Resistance of secondary winding | @ $T_A$ = 70 °C | 80 | | Ω |
| | | @ $T_A$ = 85 °C | 85 | | Ω |
| $m$ | Mass | | 18 | | g |
| | Standards | | EN 50178: 1997 | | |
| | | | UL 508: 2010 | | |

Notes: [1] Measuring range limited to ±60 $A_{max}$
[2] Measuring range limited to ±55 $A_{max}$
[3] Result of the coercive field of the magnetic circuit
[4] For a $di/dt$ = 200 A/µs.

### Features

- Closed loop (compensated) current transducer using the Hall effect
- Insulating plastic case recognized according to UL 94-V0.

### Advantages

- Excellent accuracy
- Very good linearity
- Low temperature drift
- Optimized response time
- Wide frequency bandwidth
- No insertion losses
- High immunity to external interference
- Current overload capability.

### Applications

- AC variable speed drives and servo motor drives
- Static converters for DC motor drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications.

### Application domain

- Industrial.

50 mm Diameter Incremental Rotary Encoders

# E50 Series

## INSTRUCTION MANUAL

TCD210020AB

Autonics

Thank you for choosing our Autonics product.
**Read and understand the instruction manual and manual thoroughly before using the product.**
**For your safety, read and follow the below safety considerations before using.**
**For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.**
Keep this instruction manual in a place where you can find easily.
The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.
Follow Autonics website for the latest information.

## Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

**⚠ Warning** Failure to follow instructions may result in serious injury or death.

01. **Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)**
    Failure to follow this instruction may result in personal injury, economic loss or fire.
02. **Do not use the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**
    Failure to follow this instruction may result in explosion or fire.
03. **Install on a device panel to use.**
    Failure to follow this instruction may result in fire.
04. **Do not connect, repair, or inspect the unit while connected to a power source.**
    Failure to follow this instruction may result in fire.
05. **Check 'Connections' before wiring.**
    Failure to follow this instruction may result in fire.
06. **Do not disassemble or modify the unit.**
    Failure to follow this instruction may result in fire.

**⚠ Caution** Failure to follow instructions may result in injury or product damage.

01. **Use the unit within the rated specifications.**
    Failure to follow this instruction may result in fire or product damage.
02. **Do not short the load.**
    Failure to follow this instruction may result in fire.
03. **Do not use the unit near the place where there is the equipment which generates strong magnetic force or high frequency noise and strong alkaline, strong acidic exists.**
    Failure to follow this instruction may result in product damage.

## Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, It may cause unexpected accidents.
- 5 VDC⎓, 12 - 24 VDC⎓ power supply should be insulated and limited voltage / current or Class 2, SELV power supply device.
- For using the unit with the equipment which generates noise (switching regulator, inverter, servo motor, etc.), ground the shield wire to the F.G. terminal.
- Ground the shield wire to the F.G. terminal.
- When supplying power with SMPS, ground the F.G. terminal and connect the noise canceling capacitor between the 0 V and F.G. terminals.
- Wire as short as possible and keep away from high voltage lines or power lines, to prevent inductive noise.
- For Line driver unit, use the twisted pair wire which is attached seal and use the receiver for RS-422A communication.
- Check the wire type and response frequency when extending wire because of distortion of waveform or residual voltage increment etc. by line resistance or capacity between lines.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

## Cautions during Installation

- Install the unit correctly with the usage environment, location, and the designated specifications.
- Do not load overweight on the shaft.
- Do not put strong impact when insert a coupling into shaft.
  Failure to follow this instruction may result in product damage.
- When fixing the product or coupling with a wrench, tighten under 0.15 N·m.
- If the coupling error (parallel misalignment, angular misalignment) between the shaft increases while installation, the life cycle of the coupling and the encoder can be shorten.
- Do not apply tensile strength over 30 N to the cable.

## Ordering Information

This is only for reference, the actual prodcut does not support all combinations.
For selecting the specified model, follow the Autonics website.

E50 S 8 - ❶ - ❷ - ❸ - ❹ - ❺

**❶ Resolution**
Number: Refer to resolution in 'Specifications'

**❷ Output phase**
2: A, B
3: A, B, Z
4: A, $\overline{A}$, B, $\overline{B}$
6: A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$

**❸ Control output**
T: Totem pole output
N: NPN open collector output
V: Voltage output
L: Line driver output

**❹ Power supply**
5: 5 VDC⎓ ± 5%
24: 12 - 24 VDC⎓ ± 5%

**❺ Connection**
No mark: Axial cable type
C: Axial cable connector type
CR: Axial connector type
CS: Radial connector type

## Product Components

- Product
- Instruction manual
- Bolt × 7
- Coupling × 1
- Bracket × 1

## Sold Separately

- Connector cable: CID6S-□, CID9S-□

## Connections

- Unused wires must be insulated.
- The metal case and shield cable of encoders must be grounded (F.G.).
- F.G. (Frame Ground) must be grounded separately.

### ■ Totem pole / NPN open collector / Voltage output

| Pin | Color | Function | Pin | Color | Function |
|---|---|---|---|---|---|
| 1 | Black | OUT A | 4 | Brown | +V |
| 2 | White | OUT B | 5 | Blue | GND |
| 3 | Orange | OUT Z | 6 | Shield | F.G. |

● M17 6-pin layout


### ■ Line driver output

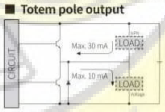
| Pin | Color | Function | Pin | Color | Function |
|---|---|---|---|---|---|
| 1 | Black | OUT A | 5 | White | OUT B |
| 2 | Red | OUT $\overline{A}$ | 6 | Gray | OUT $\overline{B}$ |
| 3 | Brown | +V | 7 | Orange | OUT Z |
| 4 | Blue | GND | 8 | Yellow | OUT $\overline{Z}$ |
| — | — | — | 9 | Shield | F.G. |

● M17 9-pin layout

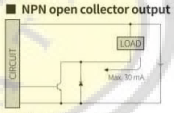

## Inner Circuit

- Output circuits are identical for all output phase.

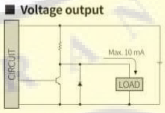
### ■ Totem pole output



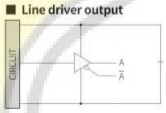

### ■ NPN open collector output




### ■ Voltage output




### ■ Line driver output



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