# DESCRIPTION

The fundamental of SP6025 synchronous rectifier (SR) driver IC combines our U.S. patented methods that utilize the principle of "prediction" logic circuit and current mode. The IC deliberates previous cycle timing to linear control the SR in present cycle by "predictive" algorithm that makes adjustments to the turn-off time, in order to achieve maximum efficiency and avoid cross-conduction at the same time. SP6025 is designed Specially, for LLC applications, and variable switching frequency system.

The SP6025 is a dual, fast turn-off intelligent controller to drive two N-ch power MOSFETs in LLC resonant converters for synchronous rectification.

# FEATURES

- Offers efficiency improvement over Schottky Diode.
- Low Standby Power to meet DOE Lot 6 Requirement.
- Dual gate driver for N-channel MOSFETs
- Prediction gate timing control.
- Minimum MOSFET body diode conduction.
- Self-detect DCM /CCM to enhance the performance under the variable switching frequency condition.
- Current mode operation in DCM, Prediction mode control in CCM.
- Operating frequency up to 250 KHz.
- Synchronize to transformer secondary voltage waveform.
- Rapid tacking function in prediction mode to adapt rapid load changing.
- Multi-blanking time to avoid the interference of turn on noise.

### APPLICATIONS

- Storage area network power supplies
- Telecommunication converters
- Embedded systems
- Industrial & commercial systems using high current processors

### **PIN CONFIGURATION (SOP-8)**



# PART MARKING





# TYPICAL APPLCATION CIRCUIT



#### **PIN DESCRIPTION**

| Pin | Symbol  | Description  |
|-----|---------|--|
| 1   | MOSG_CL | MOSFET_L gate driver.                                    |
| 2   | PGND    | Power ground connection.                                 |
| 3   | TIMING  | Discontinuous current filter timing adjustment resistor. |
| 4   | SYNC_L  | Synchronized signal from the $V_{DS}$ of SR MOSFET.      |
| 5   | GND     | Source pin ground connection.                            |
| 6   | SYNC_R  | Synchronized signal from the $V_{DS}$ of SR MOSFET.      |
| 7   | VDD     | DC supply voltage.                                       |
| 8   | MOSG_CR | MOSFET_R gate driver.                                    |

# **BLOCK DIAGRAM**



### **ORDERING INFORMATION**

| Part Number | Package | Part Marking |
|-------------|---------|--------------|
| SP6025S8RGB | SOP-8   | SP6025       |

\* SP6025S8RGB : Tape Reel ; Pb – Free ; Halogen - Free

# ABSOULTE MAXIMUM RATINGS ( $T_A=25^{\circ}C$ , unless otherwise specified.)

The following ratings designate persistent limits beyond which damage to the device may occur.

| Symbol            | Paramete                                    | Value      | Unit |
|-------------------|---|------------|------|
| V <sub>DD</sub>   | DC Supply Voltage                           | 40         | V    |
| SYNC-R/L          | Sync input pin                              | 40         | V    |
| MOSG-R/L          | Output pin                                  | 12         | V    |
| TIMING            | In/Out pin                                  | 5.5        | V    |
| I <sub>OUT</sub>  | Peak Source Current (Pulsed)                | 0.35       | А    |
|                   | Peak Sink Current (Pulsed)                  | 2.0        | А    |
| P <sub>D</sub>    | Power Dissipation @ $T_A = 85^{\circ}C$ (*) | 0.45       | W    |
| TJ                | Operating Junction Temperature Range        | -40 to125  | °C   |
| T <sub>STG</sub>  | Storage Temperature Range                   | -40 to 150 | °C   |
| T <sub>LEAD</sub> | Lead Soldering Temperature for 5 sec.       | 260        | °C   |

### THERMAL RESISTANCE

| Symbol  | Paramete                                   | Value | Unit |  |  |
|---|--|-------|------|--|--|
| Roja  | Thermal Resistance Junction to Ambient (*) | 150   | °C/W |  |  |
| *)The power dissipation and thermal resistance are evaluated under copper board mounted with free air conditions. |  |       |      |  |  |



# **ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub>=25°C, V<sub>DD</sub>=24V, Freq. =50 KHz, Duty Cycle=50%, unless otherwise specified.)

| Symbol                      | Parameter   | Conditions   | Min. | Тур.        | Max. | Unit  |
|-----------------------------|---|--|------|-------------|------|-------|
| SUPPLY INPU                 | Г   |  |      |             |      |       |
| I <sub>DD</sub>             | Communit  | No load  |      | 3           |      | mA    |
|                             | Supply current  | Vsync=0V, (Sleep mode)                                     |      | 0.22        |      | mA    |
| V. Clamp                    | Clamp voltage   | I <sub>DD</sub> =1mA                                       |      | 37          |      | V     |
|                             |   | I <sub>DD</sub> =5mA                                       |      | 38.5        |      | V     |
| V <sub>DD</sub> on          | Enable voltage  |  |      | 3.5         |      | V     |
| V <sub>DD</sub> hysteresis  | Enable voltage  |  |      | 0.3         |      | V     |
| V <sub>OVP</sub>            | Over voltage protection                                   |  |      | 35          |      | V     |
| V <sub>OVP</sub> hysteresis |   |  |      | 3           |      | V     |
| SYNC REFEI                  | RENCE (SYNC)  |  |      |             |      |       |
| Vsync_on                    | Turn-on threshold   |  |      | -250        |      | mV    |
| Vgate_low                   | Gate pull low threshold                                   |  |      | -35         |      | mV    |
| Vsync_off                   | Turn-off threshold  |  |      | 20          |      | mV    |
| Isync                       | Sync input current  |  |      |             | 30   | mA    |
| Vsync_clamp                 | Sync clamp voltage  |  |      | $V_{DD}$ +1 |      | V     |
| CONTROL C                   | IRCUIT SECTION  |  |      |             |      |       |
| TDon                        | Turn-on delay   | $C_{LOAD}$ =4.7nF, $V_{GS}$ =2V                            |      | 210         |      | nS    |
| TDoff                       | Turn-off total delay                                      | $V_{SYNC}=0V, C_{LOAD}=4.7nF, R_{GATE}=0\Omega, V_{GS}=2V$ |      | 60          |      | nS    |
| TBon                        | Turn-on total blanking time                               |  |      | 1           |      | uS    |
| VBoff                       | Turn-off blanking $V_{DS}$ threshold                      |  |      | 1.8         |      | V     |
| Ttiming                     | Falling slope detection timer<br>Vsync from 1.8V to -50mV | Rtiming=100KΩ  |      | 130         |      | nS    |
| Vtiming                     | Reference Voltage   | Rtiming=100KQ  |      | 1.2         |      | V     |
| T <sub>LL1</sub>            | Light-load-enter pulse width                              | SR MOS $V_{DS}$ pulse width $< T_{LL1}$                    |      | 1           |      | uS    |
| T <sub>LL-DEL</sub>         | Light-load-enter delay                                    | Continuous counting cycles                                 |      | 4           |      | cycle |
| T <sub>LL2</sub>            | Light-load-enter pause width                              | SR MOS V <sub>DS</sub> pulse width>T <sub>LL2</sub>        |      | 20          |      | uS    |
| Tpred                       | Prediction time   | Fixed setting  |      | 200         |      | nS    |
| MOSFET GA                   | TE DRIVER(MOSG-C)   |  |      |             |      |       |
| Vout_CCM                    | Output clamp voltage in CCM                               |  |      | 9.5         |      | V     |
| Vout_DCM                    | Output clamp voltage in DCM                               |  |      | 6.5         |      | V     |
| Tr                          | Rise time   | Load=4.7nF (*)   |      | 250         |      | nS    |
| Tf                          | Fall time   | Load=4.7nF(*)  |      | 15          |      | nS    |
|                             | Pull up impedance   | Peak current   |      | 14          |      | Ω     |
|                             | Pull down impedance                                       |  |      | 0.8         |      | Ω     |

Notes: (\*) Guaranteed by design and characterization



PERFORMANCE CHARACTERISTICS (T<sub>A</sub>=25°C, unless otherwise specified.)



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