Materials Management and Component Traceability

Gain full control and real-time visibility of materials movement and status throughout the shop floor to provide for your production demands without excess inventory. Optel Materials Management provides inventory control and monitoring of production material flows to optimize production throughput.

Optel Materials Management functionality includes:

- **Real-time Inventory Management**
- **Machine Setup & Verification**
- **ERP Synchronization**
- **Component Traceability**

Deliver component traceability as a value added service to meet customer demands with Optel. Obtain work order level component traceability for the parts used on each work order. Expand to reference designator level traceability with the optional Component Level Traceability option.

ERP is the backbone of modern manufacturing and Optimal realizes customers have a heavy investment in money, time, and training for these systems. Optel’s MES is a floor control system that is designed to complement ERP systems and communicate with ERP systems to synchronize inventory and production work orders.

Optel Materials Management interfaces directly with your SMT equipment to verify the material by feeder and slot, confirm correct components are part of a work order, and track component consumption and scrap in real-time.

Materials Management is one of Optel’s family of MES product solutions as illustrated in Figure 1.

Optel insures that the right materials are kitted and all materials are verified to the work order so that jobs released to the floor are complete. Optel can receive parts into general inventory or directly to kit.

Optel Online Part Setup Verification performs real time component verification of materials, feeders and SMT machine slots as well as verifying materials for hand placement operations.

Optel tracks material returned to the warehouse so new jobs can be kitted and communicates material usage and scrap to ERP systems allowing them to adjust inventory positions.

Optel Materials Management provides inventory visibility, inventory management, storage management, control, tracking, location management and more as illustrated in Figure 2.

![Figure 1 - Optel Family of Product Solutions](image1)

![Figure 2 - Optel Materials Management Flow](image2)
Real Time Inventory Management

Optel’s Parts Material Manager allows real time insight into material inventory status, availability and location throughout the warehouse and on the factory floor as illustrated in Figure 3.

![Figure 3 - Optel Part Materials Management](image)

License Plating Materials

Optel uses a materials license plating process to associate a unique license plate identifier for each received material package (e.g., reel, tube) and records a variety of data required to verify material origin and genealogy. The license plating process links the following information about the material in a scannable format:

- Purchase order number the material was procured under
- Internal and manufacturing part number
- Manufacturer name
- Supply type (i.e. component packaging type: reel, tube, tray, bulk, etc)
- Lead free or leaded
- Quantity per material package (e.g., reel, tube)
- Date code and Lot code

Every license plate record is stored in the Optel database. License plate data can be imported from ERP, received by Optel, or defined within Optel.

Optel allows license plate reel splitting and splicing for further flexibility. The full history of a license is available in a report view. The Optel license plate view has these visual indicators:

- Components on license plate are lead-free
- Components are marked as defective
- Components are in storage

Operator may also choose to define the storage location for the material as part of receiving. Optel interfaces with common barcode printers to produce the license plate labels.

Materials Inventory Visibility

Inventory visibility across the factory floor and storage locations is provided for all material with Optel’s hierarchical inventory modeling. Optel’s Inventory View as illustrated in Figure 4, the data related to corresponding material license plates is displayed in the Report View.

![Figure 4 - Optel Material Inventory View](image)

Finding and Viewing Material Information

Optel Materials Manager provides visibility of all the materials in production on the shop floor and in the stock room including the location and state.

Material can be located by vendor, manufacture’s part number, internal part number, license plate(s), supply type, lead free, defective material and location.

Material can be tracked and placed in many states to provide the precision needed to manage each material item as:

- Created
- In Transfer
- Kitted
- On / Off Machine
- In Oven
- Supply Type
- Storage Quantity (Updated automatically by component counting)
- Received
- In Storage
- On / Off Feeder
- In Nitrogen
- Lost
- Deleted
- Quantity (Modified by manual cycle counting)
- Modified
Materials Storage Management

Storage Location Labeling - Optel Materials Management provides storage management allowing for shelves, bins, and slots to be defined and marked using letters or using numbers.

Storage Policy - Storage policy is used to find a random storage location. Available options are:

- **Group By Part Number** - Newly received material is stored as close to last license plate stored for the same internal part number. This logic will minimize operator kitting travel time.

- **Store New From Beginning, Old From End** - Newly received material is stored at first available location at the beginning of storage unit, and already used license plates are stored from end.

- **Store Old From Beginning, New From End** - Partially depleted materials are stored at the first available location at storage unit beginning, and just received materials are stored from the end.

Bar Code Label - Optel can print materials license plate bar code labels as part of the materials license plating process.

Storage Location Verification - Optel verifies material is placed in the correct storage location slot by scanning the storage location and material.

MPN Validation - Optel will verify that the material feeder type, feeder rotation and component height match data used to generate machine program for the assembly being kitting.

Materials License Plate Tracking

Location of each license plate is tracked through each transaction. Multiple license plate reports are available. As an example, a real-time license plate report and management control of lead free license plates by storage location is illustrated in Figure 5.

Finding Material - Viewing Optel license plate management screen is helpful for finding misplaced items. Or just scan all the items in a shelf to see if any are out of place. Additionally scan a license plate and show all the same part numbers with each reel's location.

Transferring Materials to another Plant

Material license plates can be transferred to another plant. The transferred material can be viewed, but not used, in the original plant unless it is transferred back.

Material Receiving

Optel offers several options for how parts can be received: via ERP system, Optel, or a blend of both.

Customers can use their ERP systems for receiving then update Optel with newly received inventory.

Alternatively turnkey to stock materials can be received in Optel, based on material requirements generated by the planning system or ERP system. Materials are received against purchase orders issued.

After the materials are received in Optel, a transaction can be electronically sent to the planning system with quantities received.

The receiving module also tracks purchase orders associated with the inventory. Multiple types of materials can be defined as in bulk, tray, tube, tape and reel. Solder paste and stencils for the screen printer can also be received into Optel Materials Management system.

Another approach supported is a blend of MRP and Optel receiving can be of benefit as in the case of using Optel for consignment materials receiving or receiving directly to kit.

Receiving Components to Optel

Materials ordered by the manufacturer for general usage or ordered as a service to the end customer are considered turnkey. Optel allows those parts to either be transferred to stock or directly to a kit when they are received. Optel will also cross reference the purchase order to assist in closing the order out in ERP.
Consigned materials are supplied by the end customer for their orders. The process is similar to receiving turnkey materials to a kit, except purchase order is not available. Consign materials are received by selecting a consign kit in the list of kits and taking the receive parts action in the Optel software.

There are several ways receiving can be structured within a plant. Customers may use all or one of the following receiving options:

- Turnkey to Stock
- Turnkey to Kit
- Consign to Stock
- Consign to Kit
- Mix Turnkey and Consign

**Kitting and Picking Inventory**

Optel assists with kitting material prior to a job being sent to the production floor. With Optel Materials Management, kitting will improve product assembly utilization while reducing downtime for the SMT line and hand assembly staff. Key kitting activities are:

- Pulling enough quantity to place each part including attrition
- Determining which reel will be used first
- Verification of component feeder type, feeder rotation, and height verification
- Lead free compliancy

An example kitting screen from Optel Part Materials Management module is illustrated in Figure 6.

**Pick Logic Type** – Pick logic determines license plate picking priorities during work order kitting. Multiple types of pick logics are supported:

- **Best Fit** – This logic picks the closest quantity to the quantity placed plus attrition. This logic is best suited for environments where it is important not to "over pick" and possible not have enough to pick for other jobs run in parallel. The problem may be larger number of license plates with smaller quantities picked which may cause excessive machine downtimes due to changeovers. To control that issue, maximum number of license plates that can be picked can be specified.

- **First In First Out (FIFO)** – License plates are picked in the order they are received until the quantity placed plus attrition is met. Best fit is used to break the tie, i.e. when picked license plates all have the same received date.

- **Pick to Clear** – License plates are picked in non-decreasing order of quantity until the quantity placed plus attrition is met. This logic will clear partial license plates and free storage space.

- **Maximum Reels on Feeders per Pick** – The number of multiple Feeders with the same parts that can be kitted in one kit.

Optel’s Part Materials Management allows many choices as to how you wish to manage your inventory such as how you pick your inventory, as illustrated in Figure 7.

*Figure 6 - Kitting in Optel Part Material Management*

*Figure 7 - Optel Picking from Storage*
**Kitting Global Attributes**

**Global Attrition %** - This is a global attrition constant, used to deduct defined quantity from each license plate when verified on machine. It is used typically to take into account amount of components lost when a license plate is mounted on a feeder.

**Kitting Type** - Kitting can be done for a schedule setup that can have multiple work orders in the setup, so called “Common Setups”, or for an individual work order. The Common Setups feature is used if the customer uses Optel Dynamic Scheduling and Machine Optimization.

**Lead and Lead Free Verification** - Only lead-free license plates can be kitted for work orders of lead-free assemblies.

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**Machine Setup and Verification**

Offline Setup and Online Setup Verification are used to reduce setup time for SMT machines and verify(track components.

- Significantly reduce the possibility of placing a wrong component
- Offline setup verification using smart feeders reduces machine down time
- Advanced part outage warning reduces machine downtime
- Material traceability data is collected in real-time

**Offline Setup**

The Offline Setup functionality is intended to be used in either the stockroom or point of use setup area to associate license plates to feeders for each work order. Later, when the feeders are installed on the machine, Optel sends the part information to the machine to reduce manual text entry and programming time.

Optel's Offline Setup assigns reels to feeders and verifies a part belongs to the work order setup.

- **Part verification** - Verifying that license plate's part number loaded on the feeder belongs to the setup.
- **Substitute parts support** - If a part is defined as substitute for a setup part, Optel allows for verification of materials for the substitute part.
- **Unloading feeders** - After a job is completed, reels are removed from feeders and Optel reports current quantity on the reel eliminating reel counting.

**Online Setup**

Online setup verification is performed on the SMT machine at assembly time. Optel verifies the SMT assembly machine’s program matches the materials and their slot locations. Optel Online Machine Setup performs the following functions:

- **Initial setup verification** - Operator scans feeder ID and slot number to verify correct feeder and material are used (no scanning required for smart feeders).
- **Feeder changeover verification** - When feeder runs out of parts, new license plated material and the feeder is scanned and verified to the setup.
- **Moving setup** - Setup can be moved from one feeder carriage to another.
- **Moving component** - A component can be moved between slots on the same machine or different machines.
- **Splicing** - For parts whose placement quantity exceeds the reel quantity, Optel supports splicing of reels so the feeder does not have to be removed. The new reel is scanned to verify the correct part for the feeder.
- **Print Setup Configuration** - Document the setup with current materials and feeders mounted.
- **Viewing Setup History** - Viewing all material kitting transactions for the current job.
- **View Material History** - View all transactions involving a particular material ID, such as when it was kitted for the job, when it was put on the feeder, or placed on the machine, etc.
- **List kitted Materials** - List of license plates kitted for the current job.
- **Feeder Unload History** - Displays transaction history for feeder unloads and reel removal.
- **Machine Status** - Optel controls job execution by locking the machine when it encounters problems with collecting the traceability data.
- **List of Scanned Panels** - List of panels that have been scanned and processed by each machine is displayed.

The Online Setup Part Verification run at each SMT assembly machine is illustrated in Figure 9.

**Figure 9 - Optel Online Machine Setup Verification**

### Component Cycle Counting & Outage Warning

Optel will keep accurate counts of components placed automatically. However there are situations when operators must manually add or remove units to or from reels, Optel will support this “Blind” manual cycle counting.

- **Component attrition tracking** - Component attrition is recorded in real time and the quantity scrapped is deducted from license plates.
- **Advanced component outage warning** - If number of panels that can be placed with remaining component quantity on a feeder falls below a threshold value, operator is warned of imminent part outage.

The Part Outage Panel Threshold can be adjusted. The threshold is the number of remaining panels at which a visual warning will be displayed to the SMT machine operator to indicate pending feeder change requirement before running out of material.

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**Component Traceability**

Optel Material Management Package can provide component traceability at the work order level and optionally at the serialized panel or circuit assembly level. The system will provide instant access to the date and lot code information for every part within a work order.

Component Level Traceability module with sterilization option adds the ability to identify the components installed per reference designator on individual circuit assemblies. Component traceability is fully integrated with other Optel modules. If the component traceability for serialized circuit assemblies option is enabled, all circuit assemblies will have reference designator level component traceability data stored in Optel with no other operator action needed (i.e. no extra scans or computer entry).

**Component Traceability Report**

Figure 10 illustrates the report generated by Optel.

**Figure 10 - Optel Component Traceability**
Work Order Hand Placement Traceability
Materials Management and Traceability of components placed manually is additionally tracked and traced as illustrated in Figure 11, including provision for alternate substitute parts.

Figure 11- Hand-placement Material Verification

ERP Synchronization
Optel is built on industry standard database protocols. If your ERP system can export data as either comma separated text, database views or SQL queries, Optel can import it. A common solution to maintain near real-time updates it to schedule the import/export process to occurs several times a day. Figure 12 below illustrates the data exchange diagram.

Figure 12 ERP synchronization

ERP Data Exchange
Example Optel – ERP exchange data follows:

- **Inventory Data** - P/Ns, quantities, date/lot codes, PO, supply type, etc.
- **BOM Data** - Assembly no., P/N, quantity, reference designator

- **Storage Locations** - P/N, location
- **Customer and Work Order Data** - Work order number, Assembly number, revision, work order quantity, dates
- **Finished Goods Inventory** - Assembly number, location
- **Usage and Scrap Report** - Work order number, P/N, quantity placed, scrap quantity

Moisture Sensitive Devices
The Moisture Sensitive Device (MSD) option provides tracking, operator alerting and reporting for moisture sensitive components.

Optel MSD feature will provide MSD time tracking and reporting by reel when it is removed from the bag, as the reel is replaced back in the bag or into a nitrogen cabinet, or when the reel is placed into an oven. As reels are scanned for use or on the SMT assembly machine, operator alerts provide minutes-left-on-reel.

Optel MSD Reporting Module will provide alerts and reports on moisture sensitive components as illustrated in Optel screen in Figure 13.

Figure 13 - Optel MSD Management

Feeder Duty Cycle Based Management
Maintenance of feeders is critical for most SMT assembly machines for successful picks, to avoid machine failures and to keep scrap rates low.

Instead of maintaining feeder by calendar time, Optel’s Feeder Duty Cycle Management provides a means to manage feeder maintenance based on the feeder’s duty cycles. This approach keeps more feeders available to operations and reduced failures and scrap rates. Feeder Management view is illustrated in Figure 14.
Secure Web based Traceability Reporting

External Customers can access selected reports about material traceability for their work orders or assemblies via a secure Web interface. The Web reporting application, as illustrated in Figure 15, provides external customers access to information about their work orders and jobs in real time based on permissions.

Obtain reports by work order, by circuit assembly, by serial number and filter by date range. Select a work order and drill down to circuit assembly PCB serial numbers.

Material Management and Component Traceability Solution Benefits

The key benefits of Optel’s Materials Management and Component Traceability solution are:

- Keep accurate on hand inventory counts to avoid expedited purchase orders
- Provide accurate kitted quantities to the floor to avoid long equipment changeovers and part shortages
- Minimize changeover time and material errors with real-time setup verification
- Production Floor Materials Management and Component Traceability to serialized circuit assembly level
- Lead free process and materials enforcement and verification
- Moisture sensitive device tracking and alerting
- Achieve quality standards for certifications through traceability
  - AS9100 standard for Aerospace Industry. Defines requirements for Quality
  - ISO 13485:2003 Medical
  - FDA Department of Health and Human Services 21 CFR Part 11 Electronic Records; Electronic Signatures
  - FDA Department of Health and Human Services 21 CFR Parts 808, 812, and 820 Medical Devices; Current Good Manufacturing Practice (CGMP)
  - International Traffic in Arms Regulations (ITAR)

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Company Contact Information

Optimal Electronics Corporation
8176 N. Mopac, Suite #230
Austin, TX 78759
(512) 372-3415 HQ  214-295-4199 Sales
www.optelco.com  sales@optelco.com

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